UNIVERSITY *of* TASMANIA

MAKING AND BREAKING THE SCREEN

A RELATIONAL ONTOLOGY OF SCREEN FORMS.

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Loren Dyer
15 December 2017

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INTRODUCTION

The screen and relational ontology

"It seems evident now that screens are a relevant part of our contemporary world. Whether at work, at home, traveling, or immersed in some form of entertainment, most of us find ourselves increasingly in front of screens – television screens, cinema screens, personal computer screens, mobile phone screens, palmtop computer screens, and so forth."

Lucas Introna and Fernando Ilharco[1]

"The language of the screen has become an actual material condition of our existence, for its geometry is not only ever-present but also manifold."

Giuliana Bruno[2]

"Our world has become a world of screens… today screens form part and parcel of the interiors of offices, hospitals and homes almost everywhere in the world. We are surrounded by and live with screens."

Jojada Verrips[3]

INTRODUCTION TO SCREEN ONTOLOGY

When introducing the screen as a subject of analysis, what is most often noted first is its ubiquity in our environment. The screen is a very successful thing, it enters our lives in many ways and performs a variety of different functions. Although screens have a long history in interactions between humans and their environments, a comparatively recent shift in the screen's materiality toward the technological has made it a more prominent part of our daily lives. The screen has become an interesting point of discussion – it can be used theoretically as a device that links discourse about human-technology interactions with discussions of human spatiality; as a connection between representational and experiential frameworks; as a device to question the nature of the 'real'. Screens often draw debates about the role of technology and representation as environmental conditions. But when it comes to defining what a screen *is*, the material screen itself – the object that takes up space – is not often found to be important.

Screens have been analysed across a variety of phenomenological and semiotic frameworks. Each of these analyses finds different, often contradictory qualities and impacts for the screen. The impetus of this thesis is to position these qualities and impacts within the structures that give rise to them. In short, this thesis describes a relational ontology of the screen that places particular emphasis on material interaction and the structures of perception. I will begin this introduction with a brief survey of key studies of the screen, looking at the approaches taken and roles defined within them. I will then introduce the main problems and aims of this thesis and outline the methodology and methods applied in this research. The introduction will close with a summary of the content of the three chapters and a brief discussion of implications.

Understanding screens

Screens have been analysed both according to what they hold in common as things; and according to the differences between their effects. Historical definitions of the term 'screen' are perhaps quite different to how we understand the term today. The origins of the term in Middle Dutch, Frankish and Proto-Germanic languages suggest a form of protection: as a shield (*scherm*) or partition (*skrank*); a barrier to something unwanted. This meaning, however, has diversified over time. Lucas Introna and Fernando Ilharco, for example, categorise the present-day significance

1. Lucas D. Introna and Fernando M. Ilharco, "On the Meaning of Screens: Towards a Phenomenological Account of *Screenness,*" *Human Studies* 29 (2006): 57.
2. Giuliana Bruno, *Surface: Matters of Aesthetics, Materiality and Media* (Chicago: University of Chicago Press, 2014), 7.
3. Jojada Verrips, "'Haptic Screens' and Our 'Corporeal Eye'," *Etnofoor* 15, no. 1/2 (2002): 21

of the 'screen' along three main themes: projecting/showing (e.g., TV screen), hiding/protecting (e.g., fireplace screen), and testing/selecting (e.g., screening the candidates)."[4] Introna and Ilharco find that screens are united by an ability to "call for attention" by presenting information that is already presumed relevant.[5] Taking a classical phenomenological approach, Introna and Ilharco address the screen non-contextually. Their research performs a detailed analysis of the conditions of possibility of screenness – that is, the always already present conditions that allow us to recognise a screen as a screen. Using this approach, Introna and Ilharco propose that the essence of the screen lies in "holding our attention and framing relevance."[6] However, understanding the screen as a common essence is problematic for design. Defining the screen through this commonality neglects the changing impacts it can have, and the different forms it can take.

Art historian Amelia Jones considers the commonalities of screens by focusing on their effect on self-representation. The commonality of the screen in her discussion lies in representation, in the contributory role of the image of the self in identity and subjectivity. She writes that "from the early modern period onward, the notion of self is bound up with complex beliefs about representation, and in turn with the development of imaging technologies." Jones examines the representation of bodies, noting that semiotics becomes a less effective framework for examining these representations as the image itself begins to move, as in video works. Jones argues that the ability to read a pure image of the body, "as a 'sign' for something else – the person or thing," becomes polluted by action and intent, and the analytical eye becomes less easy to apply.[7]

Media theorist Anne Friedberg also uses representation as a way of examining the screen, but does so by way of metaphor. In her book *The Virtual Window: From Alberti to Microsoft*, Friedberg explores the screen using the window as a literary device in order to show commonalities in the ways that space is produced across different screens. However, she also begins to introduce differences across the spatial representations of screens, touching on technologies such as the camera obscura, cinema, television and computer, and connecting each to changes in the way in spatial representation and perception.

There are, of course, differences between the things that are called a screen, both in their materiality and in their spatial representation. The role of these differences is equally important to the commonalities amongst screens. Screens as objects, particularly, are not a uniform entity, even amongst their individual types. For instance, Anna McCarthy discusses the variation amongst the experience of television, remarking on its "malleable and heterogeneous physical form… encompass[ing] giant video walls and video banks, flat screens that look like illuminated

signs, small and large consoles."[8] Experience suggests that television affects our behaviour and our environment differently depending on whether it is present as a small screen in our homes or as a bank of screens in an art installation, a billboard in a shop window or a distraction in a waiting room. The term 'television' alone covers a range of objects and experiences.

The differences amongst screens are even greater when considered across their individual types. Technological screens are often seen as entering everyday life with the advent of cinema. Although screen forms such as the camera obscura pre-date the cinema, the popularity of cinema as a representational medium generated not just the new spatial typology in which it was housed – the movie theatre – but also new spatial typologies that supported movie-making; along with new social rituals and ways of working. The impact of cinema on spatial and social understanding includes not just the space that is represented, but also the space that is created around the cinema.[9]

As the technological screen broke free of its specific place of the movie theatre and entered more and more public and private spaces, the analysis of its role in our lives became more complex. Television was met with discourse that was both admiring and fearful, and provoked artistic experiments that challenged its role in perception and identity. Some of these experiments drew specific attention to the spatial qualities of the object of the television, such as Paul McCarthy's *Press* (1973): "I pressed my face and upper torso against a sheet of glass with saliva acting as a lubricant against the glass – when viewing the tape, I appear to be inside the monitor pressing against the screen."[10] Others discussed its role in our social lives from an individual

4. Lucas D. Introna and Fernando M. Ilharco, "The Ontological Screening of Contemporary Life: A Phenomenological Analysis of Screens," European Journal of Information Systems 13, no. 3 (September 2004): 8
5. Lucas D. Introna and Fernando M. Ilharco, "The Ontological Screening of Contemporary Life: A Phenomenological Analysis of Screens," *European Journal of Information Systems* 13, no. 3 (September 2004): 8.
6. Introna and Ilharco, "On the Meaning of Screens," 65.
7. Amelia Jones, *Self/Image: Technology, representation, and the contemporary subject* (London: Routledge, 2006), 5; xv.
8. Anna McCarthy, "From Screen to Site: Television's Material Culture, and Its Place," *October* 98 (Fall 2001): 99.
9. Understandings of the spatial representations in cinema range from the experience of represented space to techniques of representation and their impacts. Susan Buck-Morss, for example, discusses spatial experiences of the cinematic image in her chapter "The Cinema Screen as a Prosthesis of Perception" in *The Senses Still*, ed. C Nadia Seremetakis (New York: Routledge, 1994), 45-62. Similarly, Pasi Väliaho, in "Spellbound: Early Cinema's Transformational Spaces," *Space and Culture* 16 (2013): 161-172 looks at how the represented spaces of cinema are incorporated into ongoing spatial experiences. Harper Cossar, in "The Shape of New Media: Screen Space, Aspect Ratios, and Digitextuality," *Journal of Film and Video* 61 no. 4 (Winter 2009): 3-16; and Zofia Trafas, in "Designed for Impact: Widescreen and 360-degree Cinematic Interiors at the Postwar World's Fair" *Interiors* 3 no.1–2 (2012): 143–166; look at the technologies of spatial representation, exploring changes in screening formats and their impact on spatial experience. The impact of cinema in creating its own spaces – theatres, movie sets, and even towns – is of particular interest to architectural historians. See for example Amir Ameri, "Imaginary Placements: The Other Space of Cinema" in *Journal of Aesthetics & Art Criticism* 69, no.1 (Winter 2011): 81-91; and Anne Friedberg, *The Virtual Window: From Alberti to Microsoft* (Cambridge: MIT Press, 2006), 162-170.
10. Paul McCarthy, quoted in Jones, *Self/Image*, 135.

perspective. In *Television and the Moral Imaginary: Society through the Small Screen*, sociologist Tim Dant argues that television creates a "moral imaginary" or "repository of ideas about the possible ways of living in the world."[11] Dant's approach to television takes cues from experiential phenomenology, arguing that the televisual image is inhabited using similar mechanisms to the lifeworld, and it is this mode of inhabitation that allows social mores to be transferred across it. Others again address the television on a broader sociological scale. Heidegger comments in *The Thing* that television reaches "the peak of the abolition of every possibility of remoteness," fundamentally altering space-time relations.[12] Tony Fry's edited volume *RUATV: Heidegger and the Televisual* extends this Heideggerian perspective on the television, positioning the televisual as itself an "ontological domain" that enframes experience.[13] Guy Debord's spectacle; Marshall McLuhan's 'medium as message'; and Jean Baudrillard's simulacra each comment on the role of the televisual in socio-political structures from different philosophical traditions, each finding it a highly effective medium in altering social relations.[14]

The critical theory that developed around television was, for the most part, an extension of that applied to film.[15] The technological and contextual differences between the two mediums may be substantial, but critiques of the media often draw commonality from their presentation of moving imagery, and the socio-political context for that imagery. Such conflation gave analysis of the television a certain bias. It meant that these discussions tended away from the much older role of screens in homes – such as the use of paper screens and lattices in separating space and maintaining privacy, particularly in Asian and Islamic cultures – and toward the production of imagery.[16] What was at issue in this discourse was not the spatial and material arrangement of the home, but the impact of technology on everyday (and, for the most part, Western) life. The television was used as a cutting example of the way that space and time were being fundamentally altered by technology. It was not so much the object of the television and its role in the home that was of concern, but the technology-space relation.

The effects of screens on spatiality and sociality was extended with the increase in popularity of the personal computer, when the screen's impact on work also entered into discussion. Bailey, Leonardi and Barley, for example, describe different uses of computer screens in work situations using a semiotic framework by placing the referent within the work context. They describe work that is done "on, through, or within representations" depending on whether representations are manipulated as an end point (as in graphic design work), towards a physical object for which the representation stands in (as when manipulating a robot arm remotely with a keypad) or within a representation framework (as in sending and reading email).[17] Each of these, they argue, demonstrates a different experience of working with screens.

As the screen morphed again into the portable computer, the tablet, and the smartphone, the contexts in which a person could interact with a technological screens exploded – as again did discussions of the impact of the representational aspects of these devices on everyday life. The spatial impacts of such devices have been explored at some length.[18] Michael Joyce performs an anlaysis of the spaces of the internet and its constant remaking of place. He uses the example of the location of an image of a pig "seven ninths of the way down" an internet page and its location "elsewhere, in a gif file for instance" to show that "the experience of this space ... stands metonymically both for the space of abstract structures of its representation (window, system, browser, frame) and for the composite space (the site, the web, the story, the reading) in which we experience it."[19]

The question of what a screen is is often approached within the context of media: screens become representative of systems of displaying image-based content. When considering the television or smartphone, assessment of the screen as a medium can of course be highly appropriate – carrying images and providing access to media spaces is part of what these screens do. But this approach tends to subsume the individual instance of a screen into a universal medium. The

11. Tim Dant, *Television and the Moral Imaginary: Society through the Small Screen* (London: Palgrave Macmillan, 2012), 2.
12. Martin Heidegger, "The Thing" in *Poetry, Language and Thought*, trans. Albert Hofstadter (New York: Harper and Row, 1971), 163.
13. Tony Fry, "Introduction," in *RUATV? Heidegger and the Televisual*, ed. Tony Fry (Sydney: Power publications, 1993), 12-13.
14. As established in Guy Debord, *Society of the Spectacle,* trans. Donald Nicholson-Smith (Detroit : Black & Red, 1977); Marshall McLuhan, *Understanding Media: The Extensions of Man* (New York: McGraw Hill, 1964); and Jean Baudrillard, *Simulacra and Simulation***,** trans. Sheila Faria Glaser (Ann Arbor: University of Michigan Press, 1994) respectively.
15. Helen Wheatley; in her "Introduction" in *Re-Viewing Television History: Critical Issues in Television Historiography*, ed. Helen Wheatley (London: I.B. Tauris, 2007), 1-12; remarks that television is often included as one medium within a larger set of 'media' when considering sociopolitical histories of media and communications. Dant, in *Television and the Moral Imaginary*, 72-8, states that early content for television mimicked the modes of production of cinema. He then attempts to break the ties between television and film by noting the differences in the ways they are situated and experienced.
16. Inge Daniels, for example, discusses the use of timber and paper screens in establishing permeable boundaries within Japanese homes in "Japanese Homes Inside Out," *Home Cultures* 5, no. 2 (2008): 115-140. Hanna Papanek establishes the use of carved timber screens in maintaining privacy and gendered spaces in South Asia in "Purdah: Separate Worlds and Symbolic Shelter," *Comparative Studies in Society and History* 15, no. 3 (June 1973): 289-325
17. Diane E. Bailey, Paul M. Leonardi and Stephen R. Barley, "The Lure of the Virtual," in *Organization Science* 23 no. 5 (2012): 1485.
18. James Ash, in "Emerging spatialities of the screen: video games and the reconfiguration of spatial awareness," *Environment and Planning A* 41 (2009): 2105-2124 describes video games as directly impacting spatial awareness and spatial understandings amongst those who use them. Ash notes that, as the user becomes actively involved in the production of space on screen, a number of differences present between spatiotemporal knowing in the world at large and that of video games. He considers these as spatiotemporal substitutions or re-mappings. Similar concepts of spatial extension, remapping and translation can be found in Daniel Black "Where Bodies End and Artefacts Begin: Tools, Machines and Interfaces" *Body & Society* 20 (2014): 31-60; Giorgos A. Papakonstantinou "Multimedia spatial organization: Towards a different type of cultural economy" *Technoetic Arts: A Journal of Speculative Research* 9, no. 2-3 (2011): 315-320; Chris Chesher, "Navigating sociotechnical spaces: Comparing computer games and sat navs as digital spatial media" *Convergence: The International Journal of Research into New Media Technologies* 18 (2012): 315-330.
19. Michael Joyce, "On boundfulness: the space of hypertext bodies" in *Virtual Geographies: Bodies, space, relations* ed. Mike Crang, Phil Crang and Jon May (London: Routledge, 1999), 228.

individual, material context of the screen, this television or that smartphone is lost to its role in displaying the image.

There have been studies that bring the screen closer to this material context. Anna McCarthy's work in "From Screen to Site," focuses on the placedness of screens to counter the rhetoric of derealisation. McCarthy takes a particularly material view of media, arguing for considering the material and spatial context of the screen as an object, and discussing the socio-political relevance of television screens. The images of television that she presents make clear her intent in concentrating on the material of the television, its individual physical presence rather than its action as a medium. The impact of the individual televisions is examined at on a broader scale than the individual interaction, as creating a socio-political space. It is what the material television represents that seems most of interest to McCarthy. Yan Yuan and Kathryn Smith trace similar trajectories of the socio-political meaning of the television: Yuan traces its social value as an object in Chinese migrant communities, and Smith its popularisation in post-war Britain.[20]

Screen materiality can also be viewed from the point of the image rather than the object. Laura U. Marks' understanding of the screen materiality surfaces from Film Studies. Marks' interest in the screen lies primarily with the materiality of the image. Her concept of haptic visuality has been widely adopted in screen understandings, particularly those that use experiential phenomenology.[21] Her text *Touch: Senuous Theory and Multisensory Media*, which collects and revises a series of her essays from 1993-2000, begins at the point of perception with an explication of haptic visuality as a mode of perceiving a material image. The fourth section particularly presents a series of essays that focus more strongly on 'bodies' of images. 'Video's Body, Analog and Digital' looks at the differences in structuring representation across digital and analog media, originally constructing this difference as one between electrons and information, the first of which retains a referent in the 'real', and the second of which does not. In 'How Electrons Remember', however, Marks reframes this understanding, asking whether the material basis of analog and digital video is substantially different, and showing that "digital images are existentially connected to the processes that they image."[22] 'Immanence Online' traces this materiality through various levels of the material of representation, from subatomic to social. Marks particularly notes the role of the erroneous medium is revealing its materiality, naming the 'errors' of circuits as "tiny declarations of electronic independence."[23] In her examination of image materiality, Marks moves beyond the material effect of the image and into the materiality that supports it. For Marks, different ways of encoding images support different kinds of interactions with the image. Although her critique does not explicitly extend

into the materiality of the screen, Marks certainly opens the question of the screen in regards to its material make-up and impacts.

Architectural theorist Giuliana Bruno develops Marks' ideas of image materiality and the ways it interacts with the materiality of the object. Her book *Surface: Matters of Aesthetics, Materiality and Media* attempts a "remapping [of] a genealogy of screens as material forms of projection," linking the materiality of the surface through mediums of textile, cinema and architecture.[24] These surfaces, according to Bruno, are transformative support for the material manifestation of the visual. She notes the ability of the image to co-opt a surface, saying that "when a surface condition is activated… on visual planes, it changes our notion of what constitutes the support of the image and its way of siting a medium." That is, the material identity of the screen is transformed as it 'becomes' the image. Throughout her analysis, Bruno regards the screen as a more or less passive entity, regarding it as a surface that is "acted on, plastically activated, and sculpted."[25] Any potential efficacies of the screen's materiality are left unresolved.

Alongside the seemingly sparse collection of examinations of what the materiality of screens might mean are a countless number of studies addressing its technological development and design. However, these studies tend to implicate changes in use as the main effect of screen materiality, focusing on new ways of accessing and manipulating the information presented by the screen.[26]

The screen is a pervasive form, not just materially within the environment, but also in the structures of thought and communication. A diversity of screen appearances spawns a diversity of approaches to exploring the phenomena – the examples above come from a wide variety of disciplines including art history, philosophy, cultural studies, media and communications, film-making, technology studies and architecture. Each of these understandings of screen tell us something about what the screen is, about what it means, how it acts and how it is supported. But they all seem to be about something other than the screen itself. In other words, there is

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20. Yan Yuan, "Acquiring, positioning and connecting: the materiality of television and the politics of mobility in a Chinese rural migrant community" in *Media Culture Society* 36, no. 3 (2014): 336-350. Kathryn M. Smith, "Domesticating Television: Changing Attitudes in Postwar Britain" in *Interiors* 3, no. 1–2 (2012): 23–42.
21. See, for example; Jones, *Self/Image*; Verrips, "Haptic Screens"; Karl Hansson, "Fluxus Haptics" in *Media and Materiality in the Neo-Avant- Garde,* ed. Jonas Ingvarsson and Jesper Olsson (Frankfurt am Main: Peter Lang, 2012), 51-62.
22. Laura U. Marks, *Touch: Sensuous Theory and Multisensory Media* (London: University of Minnesota Press, 2002), 161
23. Marks, *Touch*, 180.
24. Bruno, *Surface*, 107.
25. Bruno, *Surface*, 4; 101.
26. Studies focusing on developing new screen products and interfaces are not overly relevant to my argument here, but the theory of affordance, often used in these studies as a way of connecting product design to use, enters the discussion in chapter one.

a tendency in theory to approach the screen according to the images that it bears or the social meanings that it holds. These two understandings of what the screen represents – as a thing that presents symbols and a thing that is itself a symbol – draw a relation between material instances of the screen and what it means for people. However, this relation is not directly addressed. The screen is taken as a screen for people without considering how the structure of this human context might affect what is understood of screens.

Problems and aims

The screen is a hard thing to keep a hold of because it seems to encompass far more than the object that exists in space: it acts as a conceptual notion, an analogy, an encounter and an ontological mode as well as a physical artefact. However the object of the screen is still the basis of the interaction – it is the thing with which we interact. In its role of displaying imagery, the screen as a thing in itself seems to hide behind its actions. The ability of the television, for example, to display images is dependent on the material composition of its pixels; but the imagery it presents also competes with this materiality. The television can present as an object present in a room at the same time as it is a medium for imagery. Understanding the screen from the context of media often overlooks this material context, and in so doing excludes many types of screens from analysis. Some of the things that we call a "screen" are not connected to a context of display: a flyscreen for instance, or a carved timber lattice, act more as spatial barriers than sites of display. The term "screen" in its verb form also has meanings in excess of display – although I might screen a movie, I might also screen participants for a study. The screen in this second context refers to a process of filtering or sorting.

This project began with an attempt to understand the spatial and social effects of the screen. It quickly became apparent, however, that trying to understand the screen as a generalised effect did not allow difference to be incorporated into this understanding – it did not show how disparate meanings of the term 'screen' could come about, or allow for the difference in the appearance and action of screens. As such, it was not particularly useful for design. While the canonical literature that describes the effects of screens focuses on their social meanings and actions, there is little indication of how this might be contextually grounded within the material meeting of a particular person and a particular screen. There is no indication of how to translate this experience into a designed object.

Introna and Ilharco note that "we seem not to see screens qua screens."[27] This assessment seems intuitively true, and has been demonstrated in the preceding paragraphs – we do, after

all, often look through screens to images and other spaces. But on closer analysis it seems a strange sort of proposition to make. What does it mean to see a screen *as* a screen? Does it mean taking the screen as separate from the image as the cinema invites us to do? Does it refer to the material make-up of an object that takes up space, or perhaps the meaning that a human makes from the object as with McCarthy's analysis? Does it mean taking the screen according to its phenomenological conditions of possibility, as Fry and others have attempted? The screen holds a unique ontological place as it resists being understood as one thing: it is present both as representational and as actual; it produces space, occupies space, separates space and connects space; it can be highly technological or a simple built structure; and it can promote different methods of spatial engagement between people and people, and between people and objects. As a designer, my own bias encourages me to understand the screen more firmly in its materiality; to ask questions about the influence that the physicality of different screens has on the way that we understand them; and with them, ourselves and the space that surrounds us. Such questions help address the screen according to a spatial and material lineage, a field in which the screen is under-theorised.

My aim in this thesis is to describe a relational ontology for the screen, using a range of theoretical frameworks[30], in the hope of understanding the individual nuances with which the screen is understood. This relational ontology will focus on the role of materiality in the way the screen is understood, particularly discussing how concepts such as the subject, object, virtual, real, agency, and material are found within screen interactions. Before I go further to describe the project aims and structure, I will take a moment to draw some boundaries around my use of the two key terms in this aim: 'screen' and 'relational ontology'.

Screen

Using a term such as 'screen' suggests that the thing being referred to shares a common identity with other things, without defining what about this identity is common.[31] Naming a thing a 'screen', then, suggests it has a certain ontology; a set of characteristics that define it in some way. The relation between naming and ontology will be discussed more thoroughly in chapter

27. Introna and Ilharco, "On the Meaning of Screens," 62-3.
28. These frameworks are introduced in "Making screen relations", p.23.
29. In *What is a Thing?,* Martin Heidegger develops an argument in which the name of a thing is always derived from the need to point out an instance of it. Naming, for Heidegger, is demonstrative. In this way, the individual thing is always included in the universal. In his analysis included alongside the text of Heidegger's lecture, Eugene T. Gendlin writes that naming a thing, such as a screen, means that "we thereby take and know it as the same as many other things not here and now" which are also called by that name. See Martin Heidegger, *What is a Thing?*, trans. WB Barton, Jr. and Vera Deutsch, analysis by Eugene T Gendlin (Chicago: Henry Regnery Company, 1967), 260.

three when it arises as being particularly at issue; but for now this relation presents a particular problem for positioning an initial definition for the term 'screen'.

In exploring a relational ontology for the screen, I am looking for the identity of things that might be described by the term. Defining the term 'screen' is, in many ways, the central problem of this thesis. Taking this as the case, an appropriate starting point for my analysis might be any 'thing' that is commonly described by the term. Some problems come immediately to hand from this starting point. The first is in deciding what I can and cannot use as an example to begin my exploration. The term 'screen' could include any number of disparate objects, concepts and processes, and which of these I include at the outset would no doubt affect the kind of ontology I find. The objects, concepts and processes the term describes may have little in common physically. They may not have physicality at all.

As this thesis aims to understand the screen through design and to situate this understanding within the broader context of the screen, I am particularly interested in the material thing of the screen – the object that inhabits space even as it effects it. As such, I will limit my definition of the term 'screen' to the object of the screen and its context. The term 'screen' is limited here to its noun form, *a* screen or *the* screen, and particularly as it relates to a physical thing or group of things.

The second problem lies in the term 'object' and what it denotes in relation to the screen. Particularly, what part of a screen is the screen—object; and what is an object as it appears in perception? This thesis begins with the assumption that the object is the physical part of what is referred to by the term 'screen'. The role of the object in screenic perception will be discussed further in chapter one, and tested more thoroughly in chapters two and three.

Finally, there is also a common effect to screens that needs to be defined at the outset. The discussions of the impact of screens presented above tend to focus on technological screens, those that produce some sort of moving imagery. While I do not wish to limit the discussion here these screens exclusively, there have been arguments made that the motion of this imagery is what allows the characteristic effects of the screen. Rather than splitting the 'technological' from the 'non-technological', I will take forward the notion of a moving space to explore the effects of screens.[28] Lattices and other architectural screens fulfil this need, as the space seen through them is, or is capable of being, in motion. By contrast, the paper on which a photograph is printed does not allow the kind of spatial experience that seems to underpin our everyday

involvement with the term. Although photographs could be described as a kind of screen, they will not enter into this study.

The types of screens that will enter this discussion, then, will be those that have a defined physical structure and that have a relationship to moving space, either through presenting moving imagery or filtering perceptual access to existing spaces. These constraints work to anchor this project within the field of design and spatial experience. Approaching the screen as an object that defines moving space allows understandings to surface about the relation between design, the screen and space.

Occasionally, the terms 'screenness' and 'screenic' will be used; the former refers to the nature of screens, and the latter refers to things that are almost, but not quite, screens.

Relational ontology

This project attempts to look at how the screen is there in experience. Such a question is an ontological one, but it approaches ontology in a particular way. This is not the type of ontology that is looking for the common properties of the thing that hold true over time. Although the variations of form and behaviour within screens do lend themselves well to this sort of analysis, to say that the screen holds some quality by which it can be recognised generates specific assumptions that will be made apparent in the following chapters.

Instead of looking for the screen in terms of what it is, I am considering it in terms of how it comes to be. Ontology is approached in this project as a process, and particularly a process that involves embodied perception.[29] Approaching ontology in this way might imply that the being of things themselves is dependent on human perception, presenting overtones of social constructivism. I do not mean to imply, in taking this approach, that the material world itself

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30. In *Television and the Moral Imaginary,* Dant identifies the movement of the image, synchronised with sound, as important in its impact on our understanding of self, other and world. He uses the term 'continuous present' to describe the sense of becoming that attracts our mechanisms of meaning-making to the screen. Dant holds that movement is essential to employing this perceptual mechanism with the screen, and thus essential to the spatial experience of the screen. Whether or not it is possible to concretely define what constitutes 'technological' in this context, taking some screens as 'technological' and others as not would introduce a number of arbitrary divisions in to this analysis; divisions that are not directly related to the screen as a class of entities.

31. Approaching ontology and perception together situate this discussion in phenomenology. Heidegger's process of 'worlding' argues that understanding the nature of things relies on perception, so that "coming back to these entities understandingly is the existential meaning of letting them be encountered *by making them present*; that is why we call them entities 'within the world'." [Martin Heidegger, *Being and Time,* trans. John Macquarie and Edward Robinson (New York: Harper Collins, 1962), 366, emphasis added]. Merleau-Ponty perhaps best explicated this connection in his discussion of object permanence, saying that "our perception ends in objects, and the object, once constituted, appears as the reason for all the experiences of it that we have had or that we could have." Maurice Merleau-Ponty, *Phenomenology of Perception*, trans. Donald A Landes (London: Routledge, 2012), 95. Merleau-Ponty holds that things are present for humans because human perception unites sense impressions into a meaningful experience.

is contingent on human perception. Rather, I mean simply that the way that the 'screen' is understood is always dependent on the structure of human understanding. To look for a sense of the screen that is separate to the human experience oversteps the very thing that people have access to. No matter what scale or level of abstraction a person attempts to understand the screen, this understanding will always be contingent on the modes and nuances of human perception.

Describing the ontology of the screen as a perceptual process allows an approach that considers the screen in terms of its relationality. Whereas the essence and conditions of possibility of the screen occur on a scale outside of any individual encounter with it, a perceptual ontology shows the screen as being generated within an encounter.[32] The different ways in which this encounter can make sense, and what this means for understanding the screen, are the subject of the three chapters.

In any relational encounter, there are (at least) three ways of understanding how things are related. The first is by looking at the things that are related, the relata. The second is by looking at the relations themselves.[33] The third is to look at the structure of relationality – that is, how the relata and relations effect and constitute one another in an ontology. These three perspectives form the bulk of the analysis of the screen in this project, and are the structure around which the thesis chapters are divided. Each of these frameworks approaches the screen with its own priorities. Each carries assumptions and logical structures that give a particular understanding of the screen, and it is important to acknowledge the role of these structures in the understandings that are taken from analysis.

The ontology of the screen I will discuss in this thesis focuses on the screen as a relational device. The purpose of this thesis is not to find an answer as to what the screen *is*. To the contrary, I hope the following text will establish that such a task is impossible. Instead, the aim is to explore ways in which the screen surfaces in perception and understand differences in how it is approached. This includes understanding the bias inherent in different ways of looking at the screen, and connecting the structures of these analyses to what is found in the screen. By understanding these connections in each case, I hope to identify something else, something that reoccurs across these ways of looking, or escapes them entirely.

STRUCTURING THE ANALYSIS: MAKING AND BREAKING

The thesis is presented in three chapters, each of which correspond to one of the three perspectives on the relational ontology of the screen. Within these chapters, the analysis takes place in two interconnected halves, which I have called a 'making' and a 'breaking'. I will briefly outline the reasoning behind this structure, then move to discussing the conceptual underpinnings and methods of both the 'making' and 'breaking' in more detail.

The cues for the structuring of this text are taken from Jane Rendell's *Site Writing*. Rendell states that she intends site writing as a method in which "the boundary between subjects and objects is more porous and arguments are made not only directly, but through association and implication."[34] The technique results in a "situated criticism," one that is particularly effective in exploring a relational ontology because of the way in which relations are accessed. That is, relational ontology implies that things arise from encounters between other things. As mentioned, the screen is explored here as a material relation between a person and an object. However the only way of understanding this relation is from the positioning of a person – a positioning that includes particular perceptual bias. Put simply, any relational ontology of the screen will always be situated within the structure of human understanding. Acknowledging the role of this structure in what is understood situates a person within the relation.

Splitting the thesis into three perspectives allows different understandings of the screen to surface from within three different modes of thought. This makes clear the positioning of each mode in relation to the others. It also allows connections to be made between the conceptual structure of the mode of thought and the outcomes of the analysis. However it is not only the conceptual structure that affects what is understood – the methods of interrogation also affect what can be found.

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32. In this way, the screen can remain immanent rather than transcendent, opening ways of accessing ontological understandings. Manuel DeLanda takes a similar stance on relational structures in *Assemblage Theory* (Edinburgh, Edinburgh University Press, 2016).
33. In approaching relationality in this tripartite way, guidance was taken from the relational ontology of Brian John Martine's *Indeterminacy and Intelligibility* (Albany: State University of New York Press, 1992). Martine discusses the tension between the boundedness of relata (the determinate) and the openness of the constantly shifting relations that we describe them by (the indeterminate). He concludes that to consider one without the other ignores fundamental aspects of experience – the determinate and indeterminate are themselves related, bound within a structure of experience.
34. Jane Rendell, *Site Writing: The Architecture of Art Criticism* (London: IB Tauris, 2006), 2. Rendell offers a number of techniques for achieving this effect. Some of these techniques are moving across boundaries and thresholds, fluctuating pronouns, and exploiting the design of and relations between pages. She also raises the possibility of a situated writing outside text – in art or video. These techniques have been put to use in the creation of this thesis.

At the outset, it was clear that the ontology of screens has both material and representational aspects, and that these are both encountered as the 'screen' in interaction. A traditional written analysis will attempt to construct a generalised understanding. That is, it will look for *the* screen, rather than *this* screen. This generalised understanding is important to the ontology of the screen as it represents a 'making' of screen relations on the conceptual level. Finding a relational ontology from written analysis means working within a particular logic and at a particular scale; however this is not the scale at which the material context of the thing can be acknowledged.[35]

Something was needed in addition to written analysis to address the material context of the screen, and to elaborate its dynamic with the representational; something that would work at the scale of the individual occurrence in order to understand the particular thing of the screen. This individual context was found using three forms of creative practice: amateur robotics, animation and personally situated writing. Together, these methods challenge the generalised understanding of conceptual analysis by finding its limits, the places where it no longer applies. In finding (and crossing) these limits, individual occurrences 'break' the constructed generalised understandings of the screen.

Each of the forms of analysis used herein are situated, they come with their own logics and structures that affect understanding. In this thesis, the construction of the screen in written analysis sits alongside its provocation through creative practice. Importantly, it is *between* these modes that the thesis performs and that an ontology of the screen is sought.

In each chapter, the two halves of the thesis – the screens' 'making' and 'breaking' – are presented in a way that allows them to interact. In serif font, a body of text presents an argument about the ontology of the screen, representing a construction or 'making' of the screen. Alongside this text lies the 'breaking' of the screen through creative practice, presented using a variety of techniques and written in san serif font. The two halves are established in varied spatial relations across the recto and verso pages, with colour used to emphasise the method most suited to the argument.

In chapter one, the 'making' appears as a single column of text on the recto page, highlighted in red. The 'breaking' appears on the verso page in two columns. In chapter two, the significance of these two parts is inverted. The 'making' remains on the verso page, but is now presented in two columns. The layout of the text leaves space for the single column of the 'breaking' on the verso page, which is highlighted in blue. In each of these chapters, the 'making' and 'breaking'

are kept separate, and one is given priority over the other to reflect the structure of the way of looking. There are, however, connections implicit in the spatial positioning of two halves that provoke the argument being made. The reader must decide how to interrupt the flow of the prioritized argument to accommodate this 'other' information. In chapter three, the two halves are presented in a single flow of text, with the 'making' justifed toward the binding and the 'breaking' toward the margin. These pages are highlighted in green. The details of the connections between the two halves of the text, and the significances of these connections, are left implicit. In this way, an indeterminate meaning can be held between them, an excess of other possibilities that interplays in unspecified ways with the determinations to either side.

To emphasise the interconnections across the thesis, each of the chapters is conceived as a particular figure. This figure acts as a depiction of the conceptual structures of the written analysis – an axis, a plane and a field respectively – and the way in which it is interrupted by the creative practice – as a cut, a deformation and a twist respectively. The use of these three figures is discussed in the chapter summary below, as well as within each chapter itself. They are not intended simply as metaphors for reflective understanding, but as a kind of discursive performance. In each case, the written analysis and creative practice will be treated according to the appropriate figure.

The resulting analysis may feel at times like it sits on the surface of things. This is not coincidental: the screen is constituted materially as a series of surfaces, and staying on these surfaces means staying with the screen. Moreover, if the ontology of a thing is found between its determinations, as relational, then proceeding deeper into the determined forms cannot by itself reveal the thing. Analytical language has a tendency toward determination. For the most part, language involves defining experientially vague qualities and conditions, drawing boundaries around them so they so they can be compared and contrasted. Drilling down into the terms of analysis is more likely to reveal the structure of the analysis itself than the experience being described.[36] As such, this thesis is not concerned with engaging the internal structures of any of the philosophical texts discussed herein, or in approaching these bodies of work as objects of

35. Martine remarks on the confounding nature of language in finding individual instances of things within analysis: "No sooner do we try to describe the individual independently from the universal than we run into an apparently insurmountable problem: the words – any words – that are the basic toolsof the task… stand in direct logical contrast to the entities one is trying to describe as independent. The only tools available to description are already biased in favour of the universal." Martine, *Indeterminacy and Intelligibility*, 1-2.

36. A similar issue seems to motivate N. Katherine Hayles to look into the role of metaphor in scientific enquiry in "Desiring Agency: Limiting Metaphors and Enabling Constraints in Dawkins and Deleuze/Guattari," *SubStance* 94/95 (2001): 144-159. Hayles argues that metaphors are capable of opening lines of inquiry in scientific research by interacting with constraints, forming a 'push-pull dynamic' that allows a greater level of understanding than either alone. It is the power of the metaphor to refer to more than it explicitly states that is useful in this regard, as it allows possibilities to come to light that remain in excess of the actualised state

analysis in themselves. Instead, it aims to use the concepts and mechanisms described therein more pragmatically – to apply them to screen understandings.

Making screen relations

A written analysis is presented as a conceptual 'making' of screen relations, and the theory and terms that form this analysis will be established in this section. Within the chapters themselves, concepts and terms will be introduced gradually as a response to provocations arising from prior analysis rather than being explicitly stated upfront. In making this move, I intend to show that the development of the argument did not begin with this theory: rather, that it arose from the interplay of the analysis and the creative practice.

In focusing on a relational ontology, this project takes a primarily phenomenological approach. However, it also relies on poststructuralist concepts such as the assemblage. These approaches are not considered to be in conflict – rather, the systemic scale of poststructuralist logic is used to complement the more intimate scale of phenomenological experience. Using phenomenological and poststructuralist concepts side-by-side allows this thesis to explore the screen as a multifaceted experience."

The spatial design fields are no stranger to phenomenology: it is a particularly useful methodology in these fields as it allows both the material and the representational to be considered in terms of an encounter between person and thing. The engagement of body, object and space is one of the primary mechanisms that define ideas such as 'inhabitation' and 'dwelling', for instance. Phenomenology allows the thing to be discussed according to how it is experienced; not just as a matter of reflective thought, but from within a relational structure.

In performing this analysis, I will deal with two main branches of phenomenology. Heidegger's phenomenology is used as it addresses ontology in a way that stresses concepts of personhood, spatiality and things. The four main sources consulted in this project – *Being and Time*, "What is a Thing?," "The Thing," and "The Question Concerning Technology" – each approach the role of people, space and things in perception differently; allowing them to inform the thesis at crucial points as its argument evolves.[37] Maurice Merleau-Ponty, whilst being less comprehensive in his approach to the appearance of the world, defines a particular role for the body in the structures of perception. His lecture series "The World of Perception" and *Phenomenology of Perception* particularly inform arguments about materiality in chapter two.[38]

Three additional branches of thinking are also incorporated that, despite showing varying amounts of departure from phenomenology, express some methodological similarities. Both Don Ihde and Peter-Paul Verbeek have developed sets of relational constructs that they refer to as post-phenomenological. These describe a number of relations between people, technologies and the world as they impact perception (Ihde) and action (Verbeek). The analytical structure of relations as expressed in Ihde's *Technology and the Lifeworld* (1990) and Verbeek's *What Things Do* (2005) inform ideas about interaction in chapter one; and the concept of technological intentionality is used in discussing agency in chapter two.

New Materialist and Feminist theories inform the thinking behind chapter two, particularly as they place the encounter as the basis for generative relations. Diana Coole's *Rethinking Agency* (2005) and her essay 'The Inertia of Matter and the Generativity of Flesh' (2010), along with Jane Bennett's *Vibrant Matter* (2010), form the basis of a rethinking of materiality and agency as it applies to the screen. Elizabeth Grosz's approach to 'The Thing' as it appears in *Architecture from the Outside* (2001) is used alongside Heidegger's essay of the same name to develop an idea of how a screen might be defined in perception without emphasising the relation of use.

The third chapter employs aspects of the thinking of poststructuralists Gilles Deleuze and Félix Guattari, and more particularly Manuel DeLanda, to look at the connections between the screen as relata and the generative relations that underpin it. The relationship between Deleuze and phenomenology is fraught with controversy.[39] I do not wish to enter into debates about the genealogy of Deleuze's thought in this thesis, but I use the concepts of assemblage and topology as a way of approaching the relational structure of the screen in chapter three. This analysis relies heavily on DeLanda's *Philosophy and Simulation: The Emergence of Synthetic Reason* (2011) and *Assemblage Theory* (2016), along with Deleuze and Guattari's *A Thousand Plateaus*, to construct a topological understanding of the screen. The approaches of Brian Massumi and Bernard Cache (in *Parable of the Virtual: Movement, affect, sensation* (2002) and *Earth*

37. *Being and Time* was first published as *Sein und Zeit* in 1927 and translated into English in 1962. *What is a Thing* was originally given as a lecture called "Die Frage nach dem Ding. Zu Kants Lehre von den transzendentalen Grundsätzen" in 1935-6 at University of Freiberg and translated into English in 1967. "The Thing" was originally given as a lecture entitled *Das Ding,* in 1949, and was published in English in 1971. The "Question Concerning Technology" was originally published as "Die Frage nach der Technik" in 1954 and translated into English in 1977 as the title essay in a compiled volume.
38. "The World of Perception" was broadcast on French National radio in 1948 and published in English in 2004 in a book of the same name. *Phenomenology of Perception* was first published as *Phénoménologie de la perception* in 1945, and was translated into English in 1962.
39. *Although Deleuze and Guattari's thought arises outside the bounds of phenomenology, there is some discussion in the literature of the compatibility of certain poststructuralist and phenomenological concepts. See, for example, Joe Hughes, Deleuze and the Genesis of Representation (London: Bloomsbury Publishing, 2008), 3.*

Moves: The furnishing of territories respectively) in constructing relational topologies are also influential.[40]

These four branches of thinking are applied to the screen as an object of analysis. Each provides different insights into the screen. The theories will be introduced gradually as the argument develops in response to particular material or conceptual provocations, and the impact of these ideas on the understandings generated through this thesis will be made apparent as they unfold. Four established screen types are used as examples during this analysis – lattices, cinema, televisions, and portable screens such as smartphones. As the thesis progresses, the analysis relies less heavily on established screen types, looking instead toward artworks that express screen-like qualities but may not be considered screens *per se*.

Defining terms

Drawing on a broad range of disciplines raises a particular problem with terminology. Different disciplines often use the same term in different ways, or with nuances of meaning that do not directly translate from one to another. While being conscious of these complexities, this thesis will approach terminology fairly naively, a technique which Jane Bennett uses as a "postponement of a genealogical critique of objects." This thesis is interested in formalised meanings, but it is also specifically interested in the excess of these meanings. Rather than delving into the object from the outside, according to the history defined by the language of different disciplines, a "moment of methodological naivety" allows meaning to develop from inside the object; from the ways it shifts under these terms.[41] Toward this end, I have lent a certain ambiguity to the text – defining and redefining concepts as they change in application and leaving an incompleteness in definition. Occasionally, the context of a certain term as carrying meaning in a certain way will be important to the argument. In these cases, the origin and meaning of the term used will be clarified.

There are, however, nine terms that are pivotal to this thesis that will benefit from being defined up front: object, thing, subject, person, real, virtual, space, materiality and agency. These terms are interrelated and are used to explore the basis of screen ontology, both within this thesis and elsewhere. Some of these terms will be used consistently through the thesis, others will be redefined as new understandings are discovered. Establishing an initial, working definition for each of these terms will allow the argument to develop more effectively.

Of the terms I have attempted to use consistently throughout the thesis, object, thing, subject and person are the most prevalent and most important. The object and the subject are discussed

primarily as relata, set within a Cartesian opposition. The opposition between these terms, and the way that this opposition plays out in analysis, is one of the starting points for chapter one. The aim of chapter one, however, is to reveal an excess to the dichotomy of the object and the subject; and this excess will be described using the terms thing and person. This second set of terms is not an opposition, instead it describes a relation.

By using the term 'screen—object', I refer to the physical screen as it opposes the thinking subject, or the inert screen as it opposes the active subject. The screen—object thus sits as a determined form that carries ontological assumptions of discreteness and permanency, a form that is thought of in opposition to the subject. The parts of the screen that lie in excess of this permanency will be approached using the term thing. The screen—thing, then, includes something more than an inert object. It refers to the material of the screen, but also to its effects or potential effects. Within the relata-based analysis of chapter one, this might include the screen—object plus the space it divides; or the screen—object plus the idea of the screen, the ways it is represented. When discussing relations in chapter two, screen—thing might refer to the indeterminate screen; the screen as it is before it becomes determined, prior to reflexive thought. The person in this scenario shows a similar excess to the subject. Within the relata-based analysis, this term might include the subject plus their physical body; in the relation-based analysis it might refer to generative embodiment – the person before they are revealed to themselves as subject.

The second set of terms that are important to this thesis are real and the virtual. These terms will be redefined as the argument develops. In the first chapter, real and virtual refer to types of space – the real being the physical, material realm; and the virtual being the representational realm of the image. These two spaces together 'make up' the spaces of the screen, but interact in such a way to oppose one another. In the second chapter, these terms are inverted. The real is used in reference to the generative plane of relations, and the virtual to the things that are pulled out of this plane as relata – being shadows of this inaccessible realm of the real. In chapter three, the meaning of the virtual shifts again. Here the 'real' is defined as consisting of the actual *and* the virtual; the 'virtual' being that which is possible, and the 'actual' that which is present. These shifts in meaning will be explained more thoroughly as they occur.

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40. *A Thousand Plateaus* was first published as *Mille Plateaux* in 1980 and translated into English in 1987. *Earth Moves* was originally composed as the unpublished *Terre Meuble* in 1983 and translated into English in 1995.
41. Jane Bennett, *Vibrant Matter: a political ecology of things* (Durham: Duke University Press, 2010), 17. Bennett uses this approach to reveal and participate in shaping, an activity that is outside of the human.

Similar shifts in meaning occur in the last set of terms, materiality and agency. In chapter one, materiality and agency are discussed as properties that belong to relata. Particularly, materiality consists of the properties of an object and refers to the physical make-up of the thing – its largeness or smallness, for example. Likewise, agency is linked to the subject and refers to intent and efficacy, an ability to decide and bring about effect.[42] Chapter two spends some time redefining materiality and agency as processes. Materiality and agency in chapter two do not refer to the properties of relata, but are themselves generative of these properties.[43] In this shift, materiality particularly becomes more than a physical property. The definition of materiality broadens to include ontological and abstract considerations that arise during material relations. When circumstances demand, these generative materialities and agencies will be referred to as materialisation and agentialisation. In chapter three, materiality and agency become perceptual conditions for establishing a field of possibility for the screen that is both composed of and moves beyond its physical instances.

Breaking screen relations

A series of creative works are presented in tension with the written analysis as a conceptual 'breaking' of screen relations, and the methods that form this analysis are established in this section. The works played a significant role in the development of the project, and contribute to the analysis by providing an alternative access point to screen relations. They draw on a range of processes and take three major forms: material objects produced using amateur robotics, animation and video work, and personally situated writing.

The material object

The primary form of creative practice is the material object. Three sets of objects were created, each correlated with one of the three perspectives that structure this thesis. These objects work alongside other forms of creative practice, acting to sway the observations and reflections back toward the material thing. All were created using an amateur robotics platform, Arduino. I will discuss the choice of Arduino as a medium now, before introducing the three sets of objects and briefly describing their role within the chapters.

Robotics is not a common design medium in spatial design. Outside of the spatial disciplines, robotic design is most often directed towards a particular purpose and has an intimate relation with human labour, especially the mimicking or replacement of human behaviours. However, there is potential for robotics to work as a creative medium rather than a functional one. I chose this medium for two reasons: its emphasis on active materiality, and its restrictive nature.

Robotic things lend a particularly material bias to this project that more representative forms of practice would be less able to express. This materiality of the objects is particularly powerful because of its activity. Robotic things can engage with and respond to people in ways that other things cannot. Or, more accurately, robotic things make their interactivity with people very apparent. This lends robotics an advantage over other forms of object-making in this project, as the role of the material can be approached in a similar way to the role of human intent.

To maintain the role of the objects in disturbing screen relations, I was particularly interested in retaining a sense of surprise in the creative works, rather than have them address particular functions. For this reason, I chose an amateur robotics platform. This decision has two advantages for this thesis. The first of these is that it is not a medium that I am expert in as a practitioner. By maintaining an amateur relation with the creative medium, the medium has more impact on the practice. That is to say, an expert practitioner has tested limits, found boundaries and developed working procedures which allow them to express their design intent by manipulating the medium. The knowledge and skill of an expert reduces the scope for surprising events; for the medium to protest or fail in revealing ways.

The second advantage lies in the restrictive nature of the platform, and this is the major advantage of using Arduino over more developed robotics platforms. Mimicking human behaviours and structures requires substantial processing power. Platforms that use external processors are far more effectual in this regard and can perform complex and computationally involved processes, such as video analysis and pattern finding. This processing power allows human processes, such as those that structure sight, to be easily reproduced. The resultant systems often 'think' like humans.

By contrast, the Arduino Pro Mini that provides the processing platform for the objects of this thesis has only 32kB of programmable memory. Such a restrictive platform forces a change in methodology. It necessitates human engagement with machinic methods rather than applying human methods to the machine. The type of design that results is less intent-driven and occurs more as an active communication. Differences between robotic and human structures in regards

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42. These definitions follow traditional Cartesian notions of materiality and agency, in which agency belongs to the (human) subject and material is, by contrast, ineffectual; acted upon rather than active. Diana Coole; in "Rethinking Agency: A Phenomenological Approach to embodiment and Agentic Capacities," *Political Studies* 53 (2005): 125; notes that such definition pays "ontological homage to a Cartesian dualism that separates minds from bodies and spiritual from material substances."
43. The redefinition of materiality and agency as processes reference the work of Jürgen Habermas, Elizabeth Grosz, Diana Coole, Jane Bennett and others in decentring agency from the Cartesian notions of the subject and, ultimately, from the human. Coole, particularly, develops a notion of agency that focuses on capacities and their surfacing in pre-personal and trans-personal domains as well as the personal. Bennett, in *Vibrant Matter*, follows this non-personal agency to define materiality itself as active and lively.

to time, memory, and precision became particularly apparent through these processes. Chapter two, particularly, discusses how machinic engagement revealed understandings about the design process and about the screen.

Three sets of material objects were produced using these methods. In chapter one, the *Behaviour Boxes* were created to isolate and demonstrate certain aspects of the screen in a way that might stress the materiality of the object (despite this materiality not being wholly expressed). However, they did not behave as expected. Rather than demonstrating connections between subject and object, as I initially assumed they would, the *Behaviour Boxes* began to break these connections. This result framed the way that the written analysis and creative practice interact within the thesis. The *Behaviour Boxes*, particularly, seemed to disturb the dichotomy of the subject and object. This discovery exposed something important about the ontology of the screen and shaped the direction of the thesis as it developed.

The remaining works build on this sense of breaking to distort the screen in various ways, in an effort to reveal more of this excess. In chapter two, *Gaze Returner* and *Moubie* act to interrupt the ways that spatiality is produced, disturbing traditional notions of materiality and agency to show these as interconnected processes in revealing the screen. In chapter three, *Some Assembly* explores the role of pace in spatial ordering, twisting the structure of relationality to find a critical transition where something inert turns into something active. This third set of works draws attention to the structure of relationality by changing the scale at which the screen is attended to. The works are introduced more thoroughly at the beginning of each chapter and are discussed at moments throughout the chapters where they provoke new meanings or challenge the assumptions of the argument.

The works are referred to within the thesis as 'bots', a friendly abbreviation of the more formal 'robot'[44]. Each of these objects works to break screen relations in a certain way. They are somewhat screenic, but not exactly screens. Using this approach helps reveal screen ontologies by making clear what the screen is not through mechanisms that interrupt them surfacing in perception.

Animation and video

Animation and video are also used as a creative practice. Despite the robotic objects being the subject of the animations and videos, these techniques in all cases add layers of understanding to the bots themselves. As such, they are not used purely as forms of representation or documentation. They do not document the bots *per se*, rather they document my understanding of the person-screen relation provoked by the bots. They form part of an analysis of the objects,

particularly as they relate to their situation, and so stand as creative practices in their own right.

Animation is used in chapters one and two to demonstrate aspects of the human-object interaction between me and the *Behaviour Boxes*, *Gaze Returner* and *Moubie*. The technique allows a communication of the interactions between myself and the works in both design and analysis, situating my material and spatial interactions with the work. Video is used in chapter three to manipulate *Some Assembly*'s performance to allow further conditions to surface. The video that is presented as part of *Some Assembly*'s performance focuses on manipulating the pace of the work, allowing an access to the screen condition that wouldn't otherwise be available.

These two techniques present a peculiar problem to this thesis. The created objects are moving works, and any analysis of them needs to take movement into account. The ability of animation and video to represent these moving objects as it analyses them means they are the most fitting technique for interpreting the works in the thesis. However, both rely on the reader watching the interpretation through a screen. As the intent of these works is to break the ontology of the screen, inserting a commonplace and established (and unbroken) screen between the work, myself and the reader can detract from the efficacy of the works. The intact screen that the reader watches presents a paradox. This second screen may overpower the nuances of breaking undertaken by the bots.

The problem of the reader's 'second screen' is particularly apparent in chapter three, where it is directly addressed. The animations in chapters one and two make deliberate aesthetic moves to counteract this effect. De-contextualisation of the interaction from its surrounds and the addition of textures over the represented information mean that these works can easily be recognised as imaginative. The ways in which screen relations are broken is communicated in the content – it is represented within the animation by showing my interpretation of the works. In video, however, these techniques are not available. *Some Assembly* relies more heavily on the reader's direct interpretation of the work as represented. The material object exists as a direct material relation between me and the bot or set of bots. This relation is not directly accessible to you as the reader. The animations and videos sit between the me—bot relation and you.

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44. The term 'robot' was first introduced by playwright Karel Čapek in the 1920s. The term is derived from the Czech words *robotnik*, meaning serf or peasant, and *robota*, meaning forced labour. See Wesley L. Stone, "The History of Robotics" in *Robotics and Automation Handbook*, ed. Thomas R. Kurfess (London: CRC Press, 2004), 1.1.4. My contraction of the term to 'bot' attempts to diminish connotations of servitude whilst referencing the mode of production and materiality of the work.

Personally situated writing

A form of personally situated writing is used to more thoroughly elucidate my relation to both the bots and the written analysis. This writing represents my thoughts about and relations to the bots, particularly as they interact conceptually with the written analysis; acting as a bridge between the creative works and the distanced analysis of the main body of text. This text is written casually in the first person and acknowledges the ways that I am situated toward the work. It addresses the questions, orientations and intents revealed through the series of objects.

Such personally situated text suspends the distance usually present between an analyst and the object of their analysis. This distance is important, of course, and takes its place in the written analysis. Understanding the individual material context of the screen, however, requires an individual approach. I need to situate myself at this individual scale.

Each form of creative practice has its own strengths and weaknesses in expressing aspects of how the screen appears (or fails to appear) in perception. Placing these forms of situatedness alongside the written analysis allows a critical engagement in a "constant back-and-forth" between my experience as designer and interactant; your experience as a reader; and objective accounts that describe and frame the experiences of others.[45] The relational ontology of the screen that I find; my analysis; occurs across these modes of communication.

45. Diana Coole, "Rethinking Agency," 127-8. Coole notes Merleau-Ponty's hyper-dialectics as a means of situating critique. Coole argues that, since "no thinker can coincide with the lived," the situatedness of each observation needs to be acknowledged. She recommends, as a way of accessing this situatedness, "engaging critically in a constant back-and-forth between (first person) lived experience and (third person) objective accounts of it, while also experimenting with concepts that emerge from the changing world they describe."

THESIS SUMMARY

In summary, the structure of the thesis document arises from the perspectives and situations discussed above. The thesis is divided into three chapters, each responding to a particular perspective on relational ontology. Chapter one looks at the screen from the point of view of the relata, or *what* the screen is (or appears to be). Chapter two looks at the screen from the point of view of the relation, or *how* the screen surfaces. Chapter three looks at the structure of relationality of the screen, or *when* and *why* the screen surfaces as these things according to these methods. Within these chapters, my analysis is presented between a formal written analysis and a series of creative works. In splitting the analysis of the screen along these lines, I am not trying to enforce the separateness of these approaches; rather I am trying to show how they have different emphases that intrinsically rely on one another. To make this clearer, each chapter is presented as a figure that demonstrates the interrelation between the 'making' and 'breaking' of screen relations.

The first of these chapters considers the screen from the point of view of the relata. The fundamental assumption of this type of analysis is that the relata occur as pre-existing entities that enter into a reflexive relation. My entry point to the screen's ontology, then, addresses the screen according to the forms and behaviours by which it interacts, and the dichotomies that define this interaction. The purpose of this chapter is not to perform a relata-based analysis or to pose dichotomies in an attempt to describe the screen; but rather to find the slippage in those otherings and uses already posed.

The chapter begins by discussing the role of relata within relationality, and notes the reliance of a relata-based analysis on the use context, and its tendency toward dichotomisation. The written analysis in this chapter constructs the screen in terms of two major dichotomies – the subject and the object, and the real and the virtual. The relata of these dichotomies form two points, connected by a relation which draws them together and an opposition which forces them apart. The figure of this 'making' is therefore conceived as an axis. The *Behaviour Boxes* act as a device by which to explore the role of the object in realising the 'screen'. They attempt to cut the connection between relata in an incomplete way by expressing a role for themselves in the reflexive relation, working within the discursive structure to provoke slippage in relational assumptions. The chapter is thus presented as an axis and a cut.

Chapter one concludes with the observation that disappearance and negation are the ontological basis of the screen. This leads to an understanding of the screen as creating a gap, an

understanding that is linked to the assumptions made when performing a relata-based analysis. Alterity is discovered as a mechanism for interrupting the negation of the screen. The chapter also notes the importance of materiality and agency in how this view of the screen is maintained, opening the way for chapter two to invert the primacy of relata and relation in analysis.

Chapter two considers the screen from the point of view of the relations of materiality and agency. The fundamental assumption of this type of analysis inverts the assumptions of the last: relata occur as reflexive reactions to pre-existing and generative relations. The screen is considered in this chapter as being drawn out of a point of tension within materiality and agency. The purpose of this chapter is to examine how screen relata can surface differently in different contexts.

The chapter begins by discussing the role of relations within relationality as generative rather than reflexive. Materiality and agency are then reframed as non-directional, generative relations from which the screen emerges as a particular point of tension. The two processes are shown as internally competitive but mutually reliant. The written analysis in this chapter constructs the screen in terms of a homogenous plane of relations. It is only when the plane is disturbed that difference can arise between things and the relations can be understood. The figure of this 'making' is therefore conceived as a plane. *Gaze Returner* and *Moubie* act as devices by which to explore the role of agency and materiality in realising the 'screen'. They attempt to stretch the relational plane, challenging expectations in regards to the way that the screen is realised through processes of materiality and agency by expressing their own spatial relations. The chapter is thus presented as a stretched plane.

Chapter two concludes with the observation that the material directedness of the screen lies in a form of spatial ordering that occurs alongside, rather than for, humans. To engage with this form of ordering means that the onus of interaction is shifted: a person needs to find a new relation with the screen rather than the screen working for the human. The chapter particularly notes the importance of time and scale in how relata surface from relations, setting the way for chapter three to explore this structure in more detail.

Chapter three considers the screen as a structure of relationality. The fundamental assumption of this type of analysis is that relata and relations are bound within and emerge from a larger structure. The screen in this chapter is considered as a region of understanding in which relata and relations are nested within one another rather than being arranged hierarchically. The purpose of this chapter is to find the boundaries of this region – to find that point at which the screen turns in to something else or vice versa.

The chapter begins by noting the difficulty in anlaysing relata and relations separately, with different ontological priorities. It establishes a mode by which the screen can be generalised while keeping a sense of individual experience. The written analysis in this chapter constructs the screen as an indeterminate assemblage which becomes territorialised at in different ways to produce different relata and relations. The sum total of these relata and relations forms a field of possibility for the screen. The figure of this 'making' is therefore conceived as a field. *Some Assembly* act as a performance that provokes the crossing of thresholds in this field, turning a screen into a collection of pixels. The performance works to twist the field of possibilities in a way that turns one relatum into another. The chapter is thus presented as a field and a twist.

Chapter three concludes with the observation that speed, order and density act as parameters by which critical transitions take place within the field of possibilities of the screen. This leads to an understanding of the screen as having a certain pace which defines its properties, tendencies and capacities in any instance. The pace of the screen is connected back to how the screen is defined as a relatum. The chapter maps the topology of the screen as it has been revealed through this thesis. This map is not intended as an exhaustive definition of the screen, but as a suggestion of a perceptual region, and as an articulation of some of the parameters from which the screen might emerge.

A final conclusion then argues that each of the three perspectives suggests a different ontology for the screen, and that these arguments link back to assumptions embedded in the way of looking, showing that each understanding is situated within its mode.

Implications

The findings act as a topology of screen understandings. They provide insight into what screens have in common, and also into how they arise differently in their contexts. The findings contribute to the fields of media studies and spatial studies by outlining a territory of 'screenness' that includes individual encounter amongst generalised understandings; one that particularly notes the connections between how screens are understood and the assumptions and structures that craft these understandings. They provide insight into what screens have in common, but also into how they arise differently in their contexts.

The findings also work to situate design amongst other modes of understanding. For the purpose of this thesis, design is understood primarily as a methodology rather than a discipline. Design is a system of thinking and doing that pays particular attention to the role materiality plays in the meaning humans derive from their environments and objects.

Likewise, the primary role of design in this project is as a method of theoretical interrogation. That is, the things that are produced using design methodologies in this thesis – the bots, the animations and videos, the creative writing and even the thesis itself as a curated presentation of this process – are not the point of the thesis. Although the creative works do things, these things are not functionally or aesthetically driven, nor are their effects fixed. Design is used here in an explorative manner to disrupt written analysis at the same time as it works alongside it. Similar points of departure can take drastically different turns in written analysis and creative practice. That is, design acts here as a counterpoint to written analysis, providing an alternative access point, another way of looking that is outside of analytical literature.

Design is embedded in this thesis as part of a process that elucidates a series of understandings about a thing. It is not an exercise in the production of commodities, but a way of understanding – a mode of critical thought that pays particular attention to communication with materiality. When taken as proposing a methodology, the findings of this thesis have implications for the interactions and relations between theory and practice. Particularly, the thesis implies that design methods can be beneficial as tools for enriching understanding of domains of knowledge outside of the traditional design disciplines.

However, the content of this thesis, its findings about the screen, also has implications for design as a discipline. In this light, the findings of this thesis are useful for designers seeking a greater criticality in engaging with screens as tools in the design process, as mediums for conveying design information, or as the products of design. Although these outcomes are not necessarily discipline-specific, the findings of this thesis could promote conceptual understandings of the use and experience of screenic elements in a variety of design disciplines. These include architecture (such as in the experience of articulated building facades), interior architecture (such as in the experience of transparency or spatial permeability, whether this be analogue or digital), object design and industrial design (such as in the connections between material, form and understanding of a product), and user-experience design fields (such as the design of human-computer interfaces).

This is how it should be done: Lodge yourself on a stratum, experiment with the opportunities it offers, find an advantageous place on it, find potential movements of deterritorialisation, possible lines of flight, experience them, produce flow conjunctions here and there, try out continuums of intensities segment by segment, have a small plot of new land at all times. It is through a meticulous relation with the strata that one succeeds in freeing lines of flight.

Deleuze and Guattari[46]

46. Gilles Deleuze and Felix Guattari, *A Thousand Plateaus*, trans. Brian Massumi (Minneapolis: University of Minneapolis Press, 1987), 161.

CHAPTER ONE

AN AXIS AND A CUT

Relata and the ontology of the screen

STRUCTURE OF A RELATA-BASED ANALYSIS

This analysis begins with what is most immediately apparent in relational ontology – the things as they are, the relata. I will discuss here how relata are defined generally before outlining some implications of this definition for the analysis. The section will conclude with constructing the figure of the screen's making-and-breaking under these implications.

Looking at the *things* involved in relations means considering sets of relata and the way they are involved with one another. The focus of such a view lies on the character of the relata and their roles and identities within the relation. These roles and identities are defined according to the observable properties of the relatum, which allow it to interact with other relata. Because these properties belong to the relatum, each relatum is held as separable from the relation, each able to stand on its own. The relata are seen as discrete entities that pre-exist any particular encounter.[1]

The assumption that relata pre-exist and are separate from relations might cast the thing as standing alone, as being a determinate entity that is potentially uninvolved in interactions. If this is the case, it becomes tempting to see the thing according to Heidegger's *vorhandenheit* – as present-at-hand, an object available for study without reference to its context.[2] However, relata show particular types of properties that directly reference their contexts. The relatum might be considered as separable from its relations, but the types of qualities discovered in approaching a thing as relata are inherently relational. Despite the relatum holding properties that are described as though they are separate from any phenomenological encounter, these qualities are not wholly independent from it.

For example, a smartphone might be described as 'small'. 'Smallness' is thus seen as a quality or property that the smartphone has, regardless of whether or not it is involved in an encounter. Smallness is not independent of the encounter, however, as being small is inherently relational:

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1. Martine notes the tendency for things to be approached as discrete elements defined by properties in the opening to *Indeterminacy and Intelligibility* (Albany: State University of New York Press, 1992). He states: "I had started off, in a manner typical of the modern tradition, assuming that some of the things in our experience are universals, others individuals, and that in order to describe the relation between these two primary entities it would be necessary to detail something like their fundamental characteristics." Martine, *Indeterminacy and Intelligibility*, 1.
2. Heidegger discusses the present-at-hand as "wordless" – the thing removed from its context. He notes that, if objects appear according to their properties, they are isolated from their assignments and references. This is not an ontological 'reality' as it has no reference to worlding – in other words, to the relational context. Martin Heidegger, *Being and Time,* trans. John Macquarie and Edward Robinson (New York: Harper Collins , 1962), 81-2.

Behaviour Boxes

The *Behaviour Boxes* are a series of four isolated, boxed behaviours.[3] Each is a discrete entity, a thing working on its own to do something to me or my perception of space; or you and your perception of space. They're not screens. But they might be part-screens, a screen cut up into bits to better express the confluence between what it *is* and what it *does*.

Fig 1. *Behaviour Box Introduction*. [Video, 00:17].

Pitchmatcher is made from a microphone and a speaker. It runs sound through a Fourier transform, breaking your voice up into buckets of different frequencies until one of them overflows. Once it's drenched in a frequency, it'll emit this frequency. It's voice is your voice (but a little different). It represents you (but a little differently).

Mover is made from two lights, two wheels and a continuous rotation servo. It decides whether it'll go forward or backwards, it'll indicate a direction, and then it will move. Sometimes it lies though – it always moves the direction it decides, but sometimes it'll indicate the opposite direction. What it tells you it's going to do isn't always what it does.

Colourmapper is made from an Liquid Crystal Display and an infrared sensor. It bounces light off things and determines how far away they are. It maps this distance to a red value, then it shows you this colour so you can see the distance too. If you're looking at the LCD, chances are that the thing it's bouncing light off is you. It's showing you the distance created between you.

Touchbuzzer is made from touch-sensitive fabric and a vibration motor connected with a simple if-then code clause. If it feels you near it, it'll make sure you feel it too; responding to your electrical pulses with it's own. It's all about the tactility of interaction, not visual display.

something can only be small in comparison to something larger. To describe a smartphone without reference to its most common relation of encounter might be to quantify its size rather than qualify its scale. The 'smallness' of the thing would instead be described according to the dimensions of its sides, or to its overall volume. The quantification of a thing in this way approaches the object as present-at-hand, as it is removed from its phenomenological context.

The properties of relata are relational in the sense that they reference an assumed relation, but they are nevertheless taken as attributes or properties of the thing *per se*. That is, the relations into which the thing enters are assumed in the description of the relatum's properties. The properties of the relata are seen as pre-existing the perceptual encounter, and only when these properties are encountered in perception do they form relations. It follows that the focus of analysis when looking at relata is on the relatum's properties and the role they play in the assumed relation.

This basic definition of relata has two important impacts on what a relata-based analysis may be able to reveal about ontology. Firstly, in taking the relata as intrinsically holding properties of an assumed relation, the thing becomes an extension of its relational contexts. When considering relations between people and objects, this context is a human one. For example, if a thing is small and graspable, it becomes *mobile* – able to be moved. The thing itself, however, is not mobile (nor small, nor graspable) without its relation to the human. In considering these factors as properties of the things *per se*, the thing becomes an incarnation of human need or desire.[4]

Looking at the relata stresses the context of use. The parameters of the description already assume a use relation – whether a screen *is* graspable, as a relatum, is dependent on its suitability for use in-hand. In defining the parameters of the description, the context of the thing has already partially determined what it is. The thing is already *for* something – some functional, material, social aim – as this is the basis by which the properties can be discovered. The relata-based analysis of the screen requires a 'for' relation, and this relation is the basis of the way that the screen appears in perception. Importantly for the analysis, though, this use relation is not constitutive of the screen itself, which must exist separately from the relation in order to enter in to a relation of use. I will return to the idea of the 'for' relation later in the chapter.

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3. See appendices A through D for circuit diagrams and code.
4. Use, particularly, plays an important role in how things appear in perception. Heidegger identifies the use context as the primary ontological reality in ready-to-handedness: "that with which our every-day dealings proximally dwell is not the tools themselves… [but] primarily the work… The work bears with it that referential totality within which the equipment is encountered." Heidegger, *Being and Time,* 99.

A second observation is that relata-based analysis is most effective when considering pairs of relata. The simplest way to characterise the properties and roles of relata is in contrast to one another – in a relation of scale, one relata is large and the other small; in a relation of speed, one is fast and the other slow; and so on. The 'othering' of things in this manner is one of the fundamental bases of relata. As Brian John Martine notes, "no determinate position of any kind can be marked out without an intelligible other." For something to be what it is, there must be something which it is not – an 'other' by which to differentiate it. The structure of the other allows us to find "how things are different from one another while at the same time participating in a coherent whole."[5] This approach lends itself to dichotomisation. Describing the difference between relata is an effective way of qualifying their roles in the relation, and so the roles recognised for each relata tend towards extremities.[6]

However, it is important to note here that any relatum's pair is bound as much in sameness as it is in difference. For example, the positing of 'black' as the opposite of 'white' is only a useful differentiation because of the commonalities between the two. Saying instead that the opposite of white was green, or a potato, or an automobile (each of which are arguably more 'different' from white than black), is not a useful exercise as it does not allow us to understand what white *is*. A sensible opposition relies on a commonality between the two terms. Both white and black are the sum (and absence) of all colours depending on whether additive or subtractive colour systems are used. Importantly, their difference can only be understood because of this commonality. Black is chosen as an other to white because of what is already experienced of white. Although they are set up as reciprocal opposites, white is the term that has already taken ontological priority – black is defined only in terms of what it can help us understand about white. Black, as an other, becomes part of "the logical constitution" of white.[7]

The sameness inherent in this relation of opposition is generally not made explicit. The relation between relata works in tension, as the relata oppose each other; but also in compression, as they are drawn together in commonality. The dichotomous pairings nested in screen ontology are important, then, not just in how the terms are held apart, but also their commonalities. Although the oppositions within these pairs of relata are interesting, these differences are, in many ways, pre-determined by how the opposition is constructed. What escapes these dichotomous relata is as useful in understanding the ontology of the screen as what is caught within them.

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5. Martine, *Indeterminacy and Intelligibility*, 22; 39.
6. What is hot is not-cold, what is large is not-small and so on. Martine uses the example of water and fire in this respect. He first establishes that at least one not-water is needed to clarify what water is, and then shows that this not-water has to have a character of its own that enters in to the constitution of water itself. Martine, *Indeterminacy and Intelligibility*, 43-49.
7. Martine, *Indeterminacy and Intelligibility*, 47.

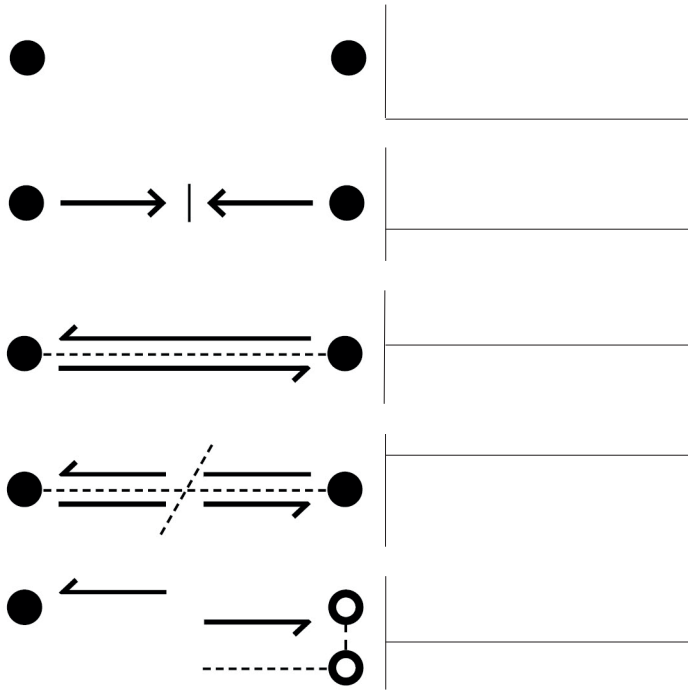

Fig 2. *Opposition and Slippage 1*.

The purpose of this chapter, then, is not to perform a relata-based analysis or to pose dichotomies to describe the screen; but to find the slippage in those otherings and uses already posed. As discussed in the previous section, it is not the relation of use itself which is of interest, nor the differences between the dichotomous pairings of the screen, but how these are constructed. This section has established that the fundamental assumption of this type of analysis is the occurrence of relata as pre-existing pairs of entities that hold properties. These properties allow the relata to enter into a relation. By focusing on these relata, the relation that is established is a reflexive one, usually characterised by its impact on the relatum considered primary.[8] In the case of the person—screen relation, the primary relatum is the person. This relation is in both tension and compression, and implicitly reveals the role the screen plays *for us*.

The figure of the written analysis begins with two points corresponding to relata. On the broadest level, these relata are a person and a screen. The diametric opposition of the termination points arises from the figuring of the points as fixed and separate to the relation – one relatum acts from one end of the axis toward the other, opposed by the force of the other. The properties of the relata are responsible for the strength and direction of the impact – from one relatum to the other. However, an incongruence is then presented, in that the properties of the relatum are already inherently relational. That is, before the opposition presents itself, a relation gives rise to their properties. To gain stronger access to the ontology of the screen, the opposition needs to be disturbed in order to reveal the assumptions of the relation. In the two-dimensional figure of the axis, this move amounts to a cut, an incomplete form of severance of each relata from their other. Care must be taken with this cut. The cut cannot sever the thing from relation entirely, or it will become present-at-hand, ceasing to be a relatum at all. The cut also cannot immerse the thing completely within the relation, or it will disappear from perception. But if the relatum begins to express itself as a function of the relation, there might be a discord produced; a slippage between the already-presumed relatum and the thing as it presents itself.

The intent of this chapter is to perform such a cut. Discursively, this will be done by identifying the relata nested within the person-screen interaction and the relational assumptions that underlie them. I will perform, in this text, a series of logical 'flips' that occur while trying to keep hold of the screen-as-relatum. A set of created objects, the *Behaviour Boxes*, will also work within this discursive structure to provoke slippage in the relational assumptions. The cut performed in this way is intended to draw out aspects of screenic ontology.

8. In Martine's example of water and fire, fire (as heat) is used to account for what makes water different, but also for its internal differences – heat is responsible for water's phase transitions between solid, liquid and gas. This is how it impacts the primary relatum of water. Martine, *Indeterminacy and Intelligibility*, 45.

Designing to cut

Sides and bottom, of which the jug consists and by which it stands, are not really what does the holding. But if the holding is done by the jug's void, then the potter who forms sides and bottom on his wheel does not, strictly speaking, make the jug. He only shapes the clay. No—he shapes the void. For it, in it, and out of it, he forms the clay into the form. From start to finish the potter takes hold of the impalpable void and brings it forth as the container in the shape of a containing vessel.

Heidegger, The Thing[9]

Design often means drawing links between the properties of the designed thing and the intended impacts, or the impacts made. The impact belongs to the thing. As a designer, I can use understandings like formal aesthetics, gestalt or semiotics to connect the things that I intend to the way that I make them. Perhaps I might use repeating vertical elements to make a 'tall' space. Perhaps I might create a forced perspective by tapering columns toward each other to exaggerate visual effect. I could then, quite reliably, say that anyone who walks into my tall space will have their eye drawn upward, experiencing 'tallness' in their own comparative smallness.

A designer makes a form makes an effect. The thing is a vehicle for the designer's intended experience. A flat relation is established: from designer, though thing, to impact. This relation has a direction and a type. The designer creates an impact, and relates to the thing to inscribe their intent. In the act of analysis, the user relates to the thing to derive an impact. The thing, always in the middle, always related to.

Can design perform a cut between relata? Can it provoke or reveal slippage in these relational assumptions? The aim of such a design method would need to challenge links between aesthetic attributes and experiential outcomes. The causality of these links would need to be weakened. Behaviours and forms might be seen instead as provocateurs, drawing attention to the thing in interaction. The thing might become something not related to but something that relates.

9. Martin Heidegger, “The Thing” in *Poetry, Language and Thought*, trans. Albert Hofstadter (New York: Harper and Row, 1971), 167.

How might such a thing be done? Could it steer away from the idea of use, of a thing for a purpose? Could it cut things up and remove them from their context, holding the relata apart so far that they sever from one another? Could it cross-code the stacked dichotomies of the relata-based analysis to disrupt its structure? Could it latch on to the thing for itself, the thing expressing its own role in the relation? Could it design *with* a screen, rather than *for* a screen?

Relata that are opposed to one another at the same time as being connected. Two forces are at play: a force of opposition, which keeps the relata apart; and a force of attraction, which keeps the relata together. If a cut is performed, what will happen to the relata? Will they be flung apart, overwhelmed by the force of opposition? Or will they gravitate towards and collapse into one another? At what point in this movement away or towards will the screen stop being a screen?

DICHOTOMISING THE SCREEN

Having established the parameters of the analysis and the aim of this chapter, this section will discuss two of the strongest dichotomies within discourse about screens. The most apparent relation between a person and a screen is that which concerns them directly as entities, discussed in terms of the *subject* and the *object*. There is also a wider context to this interaction that specifically relates to the screen's abilities to modify spatial relations. Spatiality becomes particularly at issue within screen interactions. The second dichotomy discusses the presentation of this space in terms of the *real* and the *virtual*.

The subject and the object

I will begin by discussing the construction of the opposition between subject and object generally, before examining how this construction poses a problem for understanding the screen, introducing a split between *the* screen, as a universal; and the individual screen of experience. An appropriate first step is to identify how the subject and object are held apart in their relation. This relation is between a subject and an object that interact, so the properties of the relata determine the characteristics of this interaction. The subject and the object are defined, in this case, according to differences in the ways they can interact.

The difference between

The subject and the object are best considered in this context as a difference in the ability to act and, therefore, to form a relation of interaction. The inter-reliance of subjectivity and a capacity for intentful action have a strong establishment. Elizabeth Grosz, for example, discusses subjectivity as being reliant on the capacity for action in terms of "autonomy, agency, and freedom," which she believes have been "the central terms by which subjectivity has been understood in the twentieth century and beyond."[10] Diana Coole likewise marks the role of action in phenomenology, citing Uexkull's understanding of life as "the opening of a field of action," and Maurice Merleau-Ponty's focus on embodiment being built on an understanding that the body "literally incarnates material capacities for agency."[11] Amy Allen cites Foucault and Arendt, similarly, as sharing "a central concern with the interrelationships among the concepts of power, subjectivity, and agency." She remarks that "unfortunately, Foucault himself isn't very

10. Elizabeth Grosz, "Feminism, Materialism, and Freedom" in *New Materialisms: Ontology, Agency and Politics* ed. Dianna Coole and Samantha Frost (London: Duke University Press, 2010), 139.
11. Diana Coole, "Rethinking Agency: A Phenomenological Approach to embodiment and Agentic Capacities," *Political Studies* 53 (2005): 103; 101

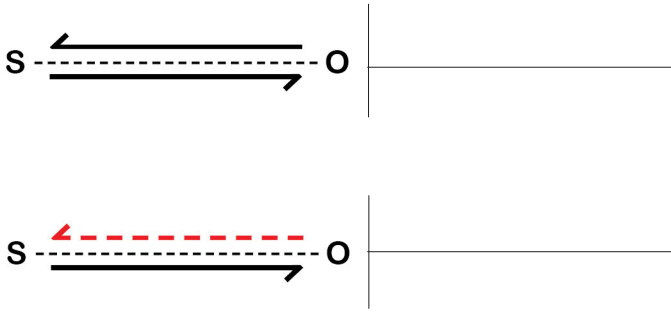

Fig 3. *Opposition and Slippage 2.*

careful with the distinction between subjectivity and agency; he tends to use the two terms almost interchangeably." Allen stresses the priority of the subject over agency, saying "it seems clear to me that subjectivity is a precondition for agency; after all, one cannot have the ability or capacity to act without having the ability or capacity to deliberate, that is, without being a thinking subject."[12] Whereas Grosz's and Coole's concerns lie primarily in displacing ideas of freedom and agency from the subject (which they achieve by taking a relation-based rather than relata-based analysis), Allen squarely states her position that agency, as the capacity to act, is an intentional construct. It belongs to the 'thinking subject,' which pre-exists any act. Intentful action, according to this form of analysis, belongs to the subject, not the object. Importing this understanding to an analysis of the screen, however, introduces a problem.

According to the parameters of relata-based analyses, the person as subject and the screen as object each act in opposition to the other. To begin with, this presents two directions of interaction: the object that affects the subject, and the subject that affects the object. Or, to stay true to form and describe these relations according to the primary relatum of the subject: the subject that is *affected by* the object, and the subject that *affects* the object. In order to maintain the separateness of the subject and the object, the object cannot be effective in its own regard. To maintain the integrity of the subject, the screen can only be used, it cannot exhibit its own agency. However, the bounds of the analysis also require that both antagonistic impacts – the subject affected and effective – be acknowledged. This seems distinctly at odds with some types of screens, such as the television, which are often described as producers of space – that is, as effective in their own right.

The problem of the effective screen

It seems at first as though these problems might be linked to the screen as a piece of technology. Similar problems arise in automated technologies as a whole, as these often constitute modes of production. The forms of agency exhibited by technologies were of some interest to Heidegger, who poses a kind of effectiveness for technology in *The Question Concerning Technology*. He addresses the problem of technological activity challenging the divide between the subject and object by de-individualising the potential activity of the object. I will now elaborate on how he approaches technology as a universal construct.

Heidegger outlines a role for technology as a system of showing the world, one whose effects are wide reaching; stating that "technology is no mere means. Technology is a way of revealing." The

12. Amy Allen, "Power, Subjectivity, and Agency: Between Arendt and Foucault," *International Journal of Philosophical Studies*, 10 no.2 (2010): 132; 135.

world, according to Heidegger, cannot reveal itself as it is because it is always already subject to an *enframing*, the assembling and ordering of things so as to be revealed in a particular way. Heidegger counters technology as a mode of revealing the world, to the mode of *poesis*, the revealing of things as they themselves are.[13]

The action of technology works separately to human intent, enframing the world to reveal it as standing-reserve – as raw material for use in technological processes. Heidegger regards the way that technology enframes the world as its essence, the true meaning of technology that endures through and underlies any particular instance of technology. The power of this enframing, and thus the agency of technology, lies in it being *a priori* to human activity, and thus to any encounter with a particular piece of technology. In this way it acts upon humanity, it "banishes man into that kind of revealing which is an ordering. Where this ordering holds sway, it drives out every other possibility of revealing."[14] The result is that non-technological ways of revealing are concealed and, because these alternatives are not immediately present, the role of technology as a *particular* mode of enframing is itself concealed. Technological enframing appears as the *only* mode of revealing. Heidegger thus presents the essence of technology as effective.[15]

Scale of effect

Heidegger's description of technology is as a relatum that holds properties of an enframing relation. Heidegger makes his reasons for this clear: he is looking for the *Wesen* or 'essence' of technology, some part of technology that holds over time and over each occurrence of technology, though itself is not necessarily technological. However, his approach has a certain directionality. By looking for an essence of technology, Heidegger is describing a thing in terms of its relation using a certain scale – that of *a* person interacting with a technological *world*. Technology is active in this collective sense, so that the world is called forth for any person already enframed by technology's essence, and technology is found within the world as a result. In this way, the technological essence avoids approaching any single piece of technology as having an individual agency. It is not a technological *object* that expresses agency, but a technological *force*.

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13. Heidegger writes: "The revealing that holds sway throughout modern technology does not unfold in a bringing-forth in the sense of poesis. The revealing that rules in modern technology is a challenging, which puts to nature the unreasonable demand that it supply energy that can be extracted and stored as such." Martin Heidegger, *The Question Concerning Technology and Other Essays,* Trans. William Lovitt, (New York: Garland Publishing, 1977), 12; 14.
14. Heidegger, *Question Concerning Technology*, 27.
15. Heidegger writes: "It seems time and time again as though technology were a means in the hands of man. But in truth, it is the coming to presence of man that is now being ordered forth to lend a hand in the coming to presence of technology." Heidegger, *Question Concerning Technology*, 37.

Heidegger contrasts his construction of technology to the instrumental view, which approaches technological interaction on the scale of *a* person interacting with *a-piece-of* technology. The term 'instrumental' describes a relation of use in which the subject affects the object, and the technological relatum is described according to its useful properties. These two views of technology address their relata on a different scale – the technological essence as universal and the instrumental as individual. The hazard that Heidegger identifies in the instrumental view is that, by concentrating on technology-as-instrument, technological enframing and its impacts are concealed: "so long as we represent technology as an instrument, we remain held fast in the will to master it. We press on past the essence of technology."[16] Essentially, if a generalisation is to be taken from the instrumental view so that something can be said about technology as a whole, the relatum of "technology" must be described according to properties generated in a relation with *a-piece-of* technology. The essence of technology as a whole, in this case, is derived from the sum of its parts; and these parts are unable to include an action on the person without abandoning the subject—object dichotomy. The description of technology that results from this conflation is neutral and does not, for Heidegger, address the essence of technology.

To be able to examine the relation in which the object can affect the subject and still maintain the separation of the subject and object, Heidegger approaches the object as a de-individualised force. Such an approach is disallowed by the instrumental view, which is considered inadequate as a result. However there is another potential hazard that might be identified in the conflation of the individual and universal, and this occurs in the opposite direction: in assuming that any single technological thing, as an instance of technology, carries the properties of a relation that is the essence of technology *as a whole*. Heidegger appears to warn against this in *The Question Concerning Technology* in the way he defines the essence that he seeks, saying "when we are seeking the essence of 'tree', we have to become aware that That which pervades every tree, as tree, is not itself a tree that can be encountered among all the other trees."[17]

If the enframing relation belonging to the essence of technology is taken as a property of the *piece-of* technology as relata, then each interaction with *a* technological thing becomes passive. In this case, the subject loses their ability to affect the object. The object, as relatum, holds the property of technological enframing, which is *a priori* to any possible interaction of the subject. By the time a person interacts with a-piece-of technology, technology has already caused them to be affected.

16. Heidegger, *Question Concerning Technology*, 32.
17. Heidegger, *Question Concerning Technology*, 4.

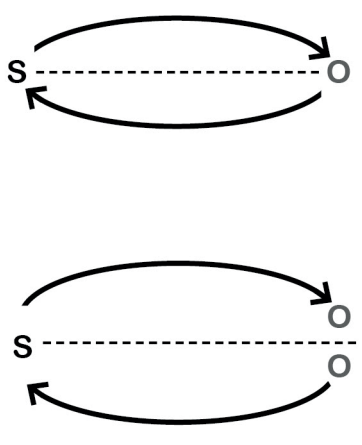

Fig 4. *Opposition and Slippage 3.*

To bring the discussion back to the person and screen as subject and object, a small gap can now be seen in the reciprocity of the relata axis. Although the 'object' in each case holds the same (often ill-defined) referent, the properties of this relatum are drawn from a different kind of relation – from a relation to a universal on the one hand and to an individual artefact on the other. The relation does not present itself as a closed loop, but as an open one. Because the relata *per se* hold the qualities of these relations as properties, there are two distinct roles to consider for the screen: a role where the person is affected by the collective 'screen', *the subject affected*, and a role where a person affects an individual screen, *the subject that affects*. I will now consider how these two points are constructed in screenic discourse.

The subject affected

When considering the screen in terms of the subject that is affected, the screen begins to take on distinctly nonmaterial properties. Rather than holding material properties related to its use by the human body as previously discussed (small, mobile, fast, etc.), the screen is found to be a type of force that acts on the embodied and/or social being of the subject, thus affecting their subjectivity.

Katherine Hayles begins to outline such an effect by considering a role for technology in identity. In the prologue to *How We Became Posthuman*, Hayles uses the Turing test as a demonstration of subjectivity being challenged by screen technologies. She maintains that the challenge does not reside in the making of a machine that thinks (and thereby must be regarded as a subject), but in the intertwining of the computer screen and human subject. This intertwining happens in two forms: for the viewer, the person attempting to determine whether their opponent is woman, man or machine, who has accepted that the screen might be human despite its separation from embodied form; and for the opponent behind the computer, who becomes an overlay of embodied and represented forms mediated through the screen. Hayles comments that the Turing test "made the crucial move of distinguishing between the enacted body, present in the flesh on one side of the computer screen, and the represented body, produced through the verbal and semiotic markers constituting it in an electronic environment." She asserts that "[t]his construction necessarily makes the subject into a cyborg, for the enacted and represented bodies are brought into conjunction through the technology that connects them."[18]

18. N. Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics*, Literature, and Informatics (Chicago: University of Chicago Press, 1999), xiii.

Pitchmatcher: a reciprocal other

Free acts come from or even through us (it is not clear if it matters where the impetus of the act originates – what matters is how it is retroactively integrated into the subject's history and continuity)… free acts, having been undertaken, are those which transform us, which we can incorporate into our becomings in the very process of their changing us .

Elizabeth Grosz[19]

The Pitchmatcher acts as I act, it talks as I talk. Am I talking to it or talking through it? Am I thinking with the Pitchmatcher towards an absent social other, or am I thinking at the Pitchmatcher as that other?

The Pitchmatcher's voice overlays mine. It mimics me like a parrot. Could I rely on this to communicate with others? Is there enough information in the tonal variation that someone might make sense of me through the Pitchmatcher? Could I merge with this device to screen myself from others? Perhaps.

Or, if I speak quickly enough, take long enough pauses, the Pitchmatcher and I could almost have a conversation. Is there enough slippage in the tonal analysis to make a meaningful difference between what I say to it and what it says to me? To make meaning of the communication *between* us? Perhaps.

Fig 5. *Pitchmatcher.*

But if I refuse to interrupt my speech patterns, If I stay myself as I am, the experience of using the Pitchmatcher is frustrating. It's constantly interrupting me, an impudent debater more intent on getting its airtime than developing its argument.

The Pitchmatcher is acting *on* me rather than *with* me, It's trying to screen my ability to impact space and communicate with my human others. It wants me to stop talking. I'm not talking *through* it, and I'm not talking *to* it. It's talking *over* me.

The role of the screen in this fundamental change of the subject is a mediatory one that affects identity, so that "the overlay between the enacted and the represented bodies is … mediated by a technology that ... can no longer meaningfully be separated from the human subject."[20]

The social screen

Hayles thus sets out an othering of the person and the screen, reinforcing the ability of the screen to influence human identity, and thereby subjectivity, through dislocating the 'subject' and 'body'. The role of the screen in this example is as a mediator, a surface onto which a person is represented in order to interact with others. Such a role strongly echoes Lacan's model of the screen in psychoanalysis.[21] Echoes of Lacanian mappings of the subject can be seen throughout screen and media studies. For example, Tim Dant and Amelia Jones present similar roles for particular screens. Tim Dant's *Television and the Moral Imaginary* refers to the television screen as a repository for possible social interactions, the site of moral development in which possibilities for being can be recognised against the images of other people and their actions. This moral role is fulfilled even "before it is switched on."[22] Amelia Jones' discussion of televisual flesh in *Self/Image: Technology, representation, and the contemporary subject* understands the screen "as a deep site of interchange where self and other recognise their profound reciprocity and even *simultaneity*… who take on constantly mutating shapes and meanings."[23]

Jones aligns the screen's ability to influence subjectivity with similar issues of fidelity in mimicking the body as a sign of the self, citing a series of works in which the screen itself is itself corporeally challenged. She writes of Paul McCarthy's *Press* (1972), for example, that the screen "refuses to allow McCarthy to escape, and thus to some extent seems to divide him from us." As the artist makes a single surface of his skin against the image, though, the screen "also *embodies* McCarthy as we experience him obnoxiously and somewhat threateningly forcing himself into 'our' space." Works that specifically address the screen in this way draw attention to its mediatory role in "marking intersubjectivity and identification as complex processes."[24]

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19. Grosz, "Feminism, Materialism, and Freedom," 146.
20. Hayles, *How We Became Posthuman*, xiii.
21. Lacan uses the word 'screen' to describe the process of meeting the gaze of the other. In Lacan's model, the screen is a conceptual surface against which a person maps themselves for presentation to the other, in anticipation of the other's gaze. In doing so, a person splits their being between representation and expectation. They receive from the other "a mask, a double… a thrown-off skin, thrown off in order to cover the frame of a shield." Jacques Lacan, *The Four Fundamental Concepts of Psycho-Analysis*, trans. Alan Sheridan (London: Penguin Books, 1979), 107. Although Lacan's use of the term screen is clearly analogous, the screen as a medium has been considered as a mediator of social relations in a similar way. Screens are a means of access to others, and they become implicated in the way that self and other are constructed.
22. Tim Dant, *Television and the Moral Imaginary: Society through the Small Screen* (London: Palgrave Macmillan, 2012), 127.
23. Amelia Jones, *Self/Image: Technology, representation, and the contemporary subject* (London: Routledge, 2006), 141.
24. Jones, *Self/Image*, 135; 140.

In following the relata-based analysis, the next step is to identify the properties of the screen relatum that allow it to affect subjectivity in these ways – as a site for the transmission of mores and exchange of identities. These properties will belong to screenness as a whole, to the essence of the screen. For this reason, Lucas Introna and Fernando Ilharco's classical phenomenological approach to the screen in their articles *The Ontological Screening of Contemporary Life: A Phenomenological Analysis of Screens* (2004) and *On the Meaning of Screens: Toward a Phenomenological Account of Screenness* (2006) can contextualise these abilities.

A screenic essence

Introna and Ilharco see the ontology of the screen as directly tied to its ability to present information. Their focus is not on individual engagements with screens, but on that which "enables us to identify each and all particular appearances of screens as 'screens' in the first place." Introna and Ilharco assert that screens are perpetually called to attention as presenting information that is *always already* presumed relevant, and hold that the screen's "central intent is a demand or a call for attention"; in that it presents, or more particularly *makes present*, relevant information.[25] This relevance, however, does not belong to the content of the screen necessarily, but to the screen itself in its use. They propose that the screen is "already implicated" in the act of screening – an act that implies that what arrives in individual experience will be "relevant for us at that particular time is happening."[26]

The pre-existent condition of screening as a process of finding relevance implies the relevance of the content presented by the screen. That is, the screen's involvement in the *always already* presumed world of screening gives it its qualities as a thing. Introna and Ilharco remark that "because the content in front of us always shows up within our involvement… it is already presumed relevant, as deserving our attention. This aspect is crucial. The content in front of us is not just presumed relevant, but is *already presumed* relevant." The meaning of the screen is thus described as "holding our attention and framing relevance," a meaning that is not given to the specifics of the content, but to the presentation of "an already screened world… which is already consistent with our ongoing involvement in that world."[27] For Introna and Ilharco, it is the ability of the screen to frame relevance that allows it to influence people.

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25. Lucas D. Introna and Fernando M. Ilharco, "On the Meaning of Screens: Towards a Phenomenological Account of *Screenness," Human Studies* 29 (2006): 61-2. Lucas D. Introna and Fernando M. Ilharco, "The Ontological Screening of Contemporary Life: A Phenomenological Analysis of Screens," *European Journal of Information Systems* 13, no. 3 (September 2004): 8.
26. Introna and Ilharco, "On the Meaning of Screens," 63.
27. Introna and Ilharco, "On the Meaning of Screens," 64-66.

Dant presents a similar argument in connecting the movement of the image and its synchronised sound to the ability of the television to hold attention. Like Introna and Ilharco, Dant draws attention to the presentation of information, but highlights the temporal as well as geographic aspects of making present. He uses the term "continuous present" to describe a sense of becoming that attracts human attention. Participation in the spatial image is dependent on this synchronicity and fidelity, and in turn allows the moral imaginary to develop. The disappearance of the screen object is crucial to this procedure, as it allows the "embodied and material process of watching" to be forgotten. Without this immersion, a critical and moral distance is maintained that weakens the ability to transmit mores.[28] For Dant, it is the television's ability to perceptually disappear that allows it to impact the subject.

Material?

The screen, in each of these analyses, is shown to be a powerful entity that has enormous potential to affect subjectivity. However, when describing the properties of the screen that arise in considerations of this kind, the screen-as-object dissipates into a kind of force. That is, although the analysis asks for properties to be responsible for the effects of the screen, these properties cannot be described without individuating the encounter. As a general relatum, the screen becomes a mediator, a repository, something that demands attention; but these qualities cannot be linked to its material form. Although these descriptions take a tentative step towards describing the screen as active, they do so in the sense of a container. The effect that was initially described as belonging to the collective of the screen is instead given to something else – the image that holds attention, or the people behind that image; as the institution of broadcast, or the artist pushing out of the television. The screen is seen as something that shapes, but that has no shape or content of its own. The activity of the screen, in each of these cases, is not an outcome of its materiality or design, but of a wider social value.

In many ways, the perceptual disappearance of the screen is to be expected from the assumptions made in regard to the effectual relation. The screen which effects is not an individual object, as its appearance as such would suggest a challenge to the subject—object dichotomy. But this also poses a problem for the analysis – if the screen is not present in perception, and has no content or effect of its own, how is it a relatum? A stronger understanding of how such a perceptual disappearance can occur might help define the screen as relatum at this scale. In this regard, I refer to Don Ihde's ideas of technological mediation.

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28. Dant, *Television and the Moral Imaginary,* 3; 94; 83.

A disappearance

Don Ihde's discussion of technology in *Technology and the Lifeworld* addresses perceptual disappearance by putting forward a set of mechanisms by which technologies intervene in the relation of intentionality between human and world. Ihde's work has been described as postphenomenological, in that it attempts to use phenomenological concepts such as embodiment and the lifeworld, while at the same time keeping hold of the materiality of technology. The aim in so doing, as discussed by Ihde's contemporary Verbeek, is to avoid an understanding of the phenomenology of technology that relies solely on its conditions of possibility.[29] That is, Ihde and Verbeek wish to address technology within interaction, rather than attempting to find its transcendental essence.

Ihde puts forth four categories of relations between humans and technologies – background, embodiment, hermeneutic and alterity relations.[30] In each of these relations, a technology intervenes in perception, which Ihde describes using the relation of I—world, in a different way. Background relations are defined through their lack of direct encounter between person and object, figured as I—world(-technology). In this regard, the technology mediates context without being recognised itself. Embodiment, hermeneutic and alterity relations involve different positioning of the technology within an encounter. Embodiment relations describe a subsumption of the technology into the body schema, as with a pair of glasses. Ihde figures these relations as (I-technology)—world, because the person and technology form a single relational entity. Hermeneutic relations conflate the technology with the world, as in reading a scientific instrument. Ihde figures these relation as I—(technology-world). Alterity relations address technology as an 'other', as the object of perception. These relations Ihde figures as I—technology (-world); as the technology is not acted through or with, but on.

Ihde's framework is initially able to maintain the subject—object dichotomy, which is then 'breached' by the formation of the two into a relational pair. The experience that Ihde describes is subject-bound. In each case, 'I' am related to the world and to technology in a different configuration, and these remain the objects of my encounter. But Ihde decentralises the subject by describing two relation where a new entity, a relational pair, is formed. In the case of hermeneutic relations, this new entity is the technological world. For the purposes of this thesis, this encounter may occur between a person and a screen-world, where the screen represents a body that can be 'read' as being perceptually present. This kind of relation might explain the

29. See Peter-Paul Verbeek, *What Things Do*, trans. Robert P Crease. (Pennsylvania: Pennsylvania State University Press, 2005).
30. See Don Ihde, *Technology and the Lifeworld: From Garden to Earth* (Bloomington: Indiana University Press, 1990), 72-111.

disappearance of the screen into the space it represents. In the case of embodiment relations, the new entity is a technological self or screen-self. Such relations might describe the use of screens to achieve aims or access spaces.

It is worth noting that Ihde's understanding of technology is somewhat broader than Heidegger's, and includes non-automated technologies such as tools. Such a definition would include lattices within the 'technology' of the screen. The role of the technology in Ihde's analysis is essentially mediatory: aspects of objects seem to be measured against a non-compositional 'baseline', presupposing a person with a set of agencies, and an object that interferes, negatively, positively or otherwise, within that set of agencies. Ihde has described two ways in which the object can disappear as perceptual focus – into the body and into the world. These are differentiated from a scenario where the object never appears in perception (background technologies), and a scenario in which the object does not disappear but remains as a perceptual other (alterity relations).

A screen-world

Following Ihde's framework, it could be said that the screen disappears within perception because its properties, which characterise it as a relatum, belong not to a screen but to a screen-world. The relation between a person and the screen-world ensures that the screen-world appears as relatum, rather than the screen itself. It is not just that the object is no longer the focus of attention – that the screen becomes ready-to-hand in some way – but that it fails to hold any relational properties of its own. The relation of effect that would allow these properties to belong to the screen also moves to some other entity.

Perhaps the most extreme example of this shift of effect is Debord's *Society of the Spectacle*, as it moves through the disappearance of the screen to a point where even the image disappears. Debord proposes a society for which the world itself has become an image – not in the sense of a collection of individual images, but as "a social relation among people, mediated by images."[31] Here Debord outlines a role for the image as a tool for maintaining socioeconomic relations. These relations, he holds, generate the technology of the 'spectacle', which is established at a mass scale as an instrument of power. Any instance of the image, or an object that holds it, is simply a support for spectacle; such that "lived reality is materially invaded by the contemplation of the spectacle whilst simultaneously absorbing the spectacular order… reality rises up within the spectacle, and the spectacle is real."[32]

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31. Guy Debord, *Society of the Spectacle,* trans. Donald Nicholson-Smith (Detroit: Black & Red, 1977), 4.
32. Debord, *Society of the Spectacle,* 8.

Two positions are shown here. As a collective subjectivity interacting with the world of the spectacle, Debord's account is socially determinist – technologies are instruments of social power systems. However, as the individual approaches the spectacle, the spectacle becomes enframing, it "subjugates living men to itself." The slippage between the collective and individual within the subject-object relation is made particularly clear here: the spectacle (as a collection of images) is not neutral, it actively works against 'men'; however it does so because of a socioeconomic power. The world is thus recognised as both technologically determined (as individual people interact with a technological world) and socially determined (as technological strategies are employed by a socioeconomic system). Debord resolves this contradiction by conflating the technology of the spectacle with the social forces that maintain it, saying that "the spectacle is nothing other than the sense of the total practice of a social-economic formation," and that the subjugation enacted by spectacle towards men happens only to the extent that "the economy has totally subjugated them."[33]

The role of the screen in this process is barely its own. The spectacle subjugates, but is in turn subjugated. The structure of the analysis does not allow any individual instance – of image or screen – to hold effect, and so these entities cannot hold the properties of this effectual relation as relata. If the image is dissolved by a "social-economic formulation," then the material that image is presented on must also dissolve. Materiality is compromised, being replaced instead by a system in which "simple images… become real beings."[34]

It is in the sense of disappearance that the screen-as-relatum is only understandable as a support or mediator; a container. However, the act of disappearing implies that the screen is revealed perceptually, that the screen has aspects that escape disappearance. It has, at the least, something which *is able to disappear* in this way. Holding on to this excess might reveal what it is that disappears.

33. Debord, *Society of the Spectacle,* 11-16.
34. Debord, *Society of the Spectacle,* 18.

The thing that refuses to disappear

It disappears. Is it that it was here, and then it wasn't; or was it just not? Can its absence be made present?

There are traces of what's left behind. Ameri's shameful blank surface of the cinema screen, made beautiful and menacing in Hiroshi Sugimoto's photographs.[35] McCarthy's televisions, sitting proudly in homes, decorated like shrines with flowers and cloths (or else, perhaps, hidden in a cabinet).[36] What do these actions of homage to the television signify – is it an indication of a social relation between the person and object?

The uncanny screen, drawing attention to itself in its 'off' state, stubbornly refusing its use. Do all screens resist in this way? The barrier of the room divider, if I pound at it trying to get in (or out), stands firm *consistently* with its use. It expresses itself through its use, and only disappears when I try to get around it by thinking through it, denying it. It is only if I succeed in breaking it that its 'off' state occurs, when I become aware that the divider wasn't the only thing stopping me. I'm still not allowed in (or out), the barrier was something immaterial all along, and I still have to cross it.

The screen resists disappearance when it expresses itself, its role in the relation. Perhaps this is in supporting this relation even when I don't want it to (a barrier is a barrier whether I'm on the inside or the outside of it). Or perhaps it is in refusing to support the relation (a blank cinema screen is stubbornly material). Either way, it remains in place despite me.

A screen expressing its role expresses a kind of alterity along with it. In its resistance to being used (specifically, used *by me*), the screen becomes an 'other'. But more than just the focus of perception, it becomes something resistant, something stubborn, something expressing itself and acting on its own behalf. It is there, when before it wasn't.

The subject that affects

If the screen is considered in terms of the subject that affects, different sets of screenic properties become available. Screens are often associated with specific uses, systems and modes of interaction.[37] The screen, in each of these cases, holds forms and behaviours that 'allow' these relations. That is, the screen is defined as 'that which allows a person to…'. To contextualise this statement in terms of Ihde's categories of relation, the screen introduces a change of personal abilities by being absorbed into the body schema. Such embodiment relations mean that the screen can be used to achieve tasks that cannot be achieved without it, such as accessing new forms of space or information. To determine the screen as relatum in this scenario means assigning properties that allow a person to affect the world through the screen. That is, the screen in this sense will hold certain properties that allow people to undertake certain actions and effects. I will briefly discuss the framework of affordances as a way of tying object properties to the ability of the subject to affect, before demonstrating that this approach poses problems when attempting to generalise from the individual encounter.

Affordances

The framework of 'affordance' relies on the parameters of a relata-based analysis to connect distinct properties of an object to particular reactions, behaviours and understandings in a subject. James Gibson, in his founding of the term, describes affordances as an ecological phenomenon, stating that "the affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill."[38] He goes on to describe a horizontal, flat, extended and rigid surface that would, by virtue of these properties, afford an animal support; taking care to note that such physical properties must be measured relative to the animal – in other words, as the properties of a relatum. The suffix used by Gibson to describe such a

35. Ameri describes attempts to hide the cinema screen behind curtains as serving "primarily ritual and ideational" purposes. The screen was considered "unsightly" when nothing was being projected onto it, as it reminded cinema-goers of the transgressions of space it would enact. Amir Ameri, "Imaginary Placements: The Other Space of Cinema" *Journal of Aesthetics & Art Criticism* 69, no.1 (Winter 2011): 87.Hiroshi Sugimoto's photographs are discussed in Anne Friedberg, T*he Virtual Window: From Alberti to Microsoft* (Cambridge: MIT Press, 2006), 150.
36. McCarthy counters the philosophical focus on the television as spreading "placelessness," which she states "makes us forget that television is an *object* and, like all objects, it shapes its immediate space through its material form." McCarthy suggests a series of very place-bound relations in which the television is treated as a material object that expresses human social values and holds meaning. This 'placed' television is found through "bothering to think about the very basic and barely noticeable physical form of television." Anna McCarthy, "From Screen to Site: Television's Material Culture, and Its Place," *October* 98 (Fall 2001): 96-7.
37. Common images of the 'couch potato', an escapist viewer, surround the television; the suburban window evokes images of nosy neighbours peering through curtains; whereas the smartphone carries with it images of public isolation as train passengers or dinner guests excuse themselves from their current temporality. In each of these cases the form of the screen is related to a type of interaction.
38. James J. Gibson, *The Ecological Approach to Visual Perception* (New York: Taylor and Francis, 2015), 119. Originally published 1986.

relatum is '-able'. The same surface might by "climb-on-able" or "fall-off-able" or "bump-into-able"depending on the intent of the animal.[39] Gibson thus outlines a strong link between the properties of the relatum and the relation, though hold that this relation is driven by the intent of the animal toward its environment. In each case, the present-at-hand observations of the surface remain the same but the properties of the relatum change, driven by a change in the relation between the surface and the body. The theory is not limited to environmental features, but can also encompass objects, other animals and people.

Gibson sets out some observations in regards to the affordances of objects. Firstly, he states that objects must have a similar size to the animal to be able to afford behaviour. Graspable objects must have a size and form factor that can be accommodated by the hand. Graspability, elongation and weight, states Gibson, afford wielding as an "extension of the arm." Graspability, compactness and weight, instead, afford throwing. Graspability, elongation and flexibility, by contrast, afford joining such as knitting or weaving.[40] Importantly, affordances rely more on vision than tactility: it is more important whether an affordance be recognised or perceived, as this allows the intent of the animal to be fulfilled or not. That is, the object has to be able to express itself in a way that makes its role in any potential relation clear.

The affordance framework is particularly useful to design, as it accommodates a predictability of effect based on design decisions; a determined connection between what things look like and do on the one hand and how they are understood and used on the other. This allows a qualifiable connection of design intent to design outcome. Affordances have been pursued in the fields of architecture and design.[41] Don Norman popularised the idea in the field of interface design, where affordance is interpreted as a method to instil an object with the ability to communicate its own use. The aim is to make the resulting object 'intuitive', in that it leverages already developed behaviours, gestures and understanding to make its operation as easy to learn as possible. Norman reflected on his approach later by narrowing his scope to "perceived affordances," where the emphasis is not on what the object allows by virtue of its materiality or physical form, but on what the "user" perceives as a "meaningful, useful action."[42]

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39. Gibson, *Ecological Approach,* 120
40. Gibson, *Ecological Approach,* 125
41. See, for example, Jonathan R. A. Maier, Georges M. Fadel and Dina G. Battisto, "An affordance-based approach to architectural theory, design, and practice," *Design Studies* 30 (2009): 393-414; and Ioannis Xenakis and Argyris Arnellos, "The relation between interaction aesthetics and affordances," *Design Studies* 34 (2013): 57-73.
42. Don Norman, "Affordances and Design," accessed August 10, 2017, http://www.jnd.org/dn.mss/affordances_and.html.

Mover: The unreliable object

"I now suggest that what we perceive when we look at objects are their affordances… what the object affords us is what we normally pay attention to."

James J. Gibson[43]

"It seems necessary and impossible to rewrite the default grammar of agency, a grammar that assigns activity to people and passivity to things"

Jane Bennett[44]

Fig 6. *Mover.*

Objects are 'for' things, and they communicate this use to me as an affordance. An object is reliable, it has a static materiality and a set of uses, which I may pick from according to the problems that arise in my perception. When new problems arise, and they are solved with an object I know, my idea of the object is updated to include this new solution. The object is additively overwritten like a text file – 1.0: this screen is for calling people. 1.1: this screen is for playing games and calling people. 1.2: this screen is for making video and playing games and calling people.

I watch the mover move. It tells me it's going to move forward, and it moves forward. It tells me it's going to move back, and it moves back. I think about what I could do with it. It's small and covers a fair amount of territory, maybe it could clean the floor with a few modifications. But then it gets it wrong – it tells me it's going forward, but it actually goes back, very quickly. It bangs into the wall, or zooms out the door.

Can an object refuse? If I try to make video on my screen, and my screen won't allow me to (this time), does it afford video-making? I've made videos with it before. The manual tells me that its software, hardware and interface have the capability to make video. But I can't make video with it now. And if *I* can't, the object isn't able to either.

What is afforded by the unreliable object? What do I do with it now?

Predicting use

It is clear that the affordance framework has a strong tie to the use relation, and to the subject recognising opportunities for action with, or through, the object. How effective the theory is as a predictor, however, rather than a descriptor, is somewhat unclear. Gibson's original examples clearly already have the use value of particular items in mind when describing their properties. Norman's description likewise relies on leveraging connections between appearance and use value that are assumed to be already known.

Daniel Black offers comments on such assumptions underlying the affordance framework. In discussing the relations between people and 'artefacts' across tools, machines and ICT, he cites early examples in engineering which struggled with the integration of the human body and the machinic. Edison's phonograph, which "toyed with the idea of providing the machine with a voice chamber modelled on the human mouth," and Knauss's early writing automatons, which eventually led to the invention of the typewriter, suggest an "initial vagueness" about how the body and machine should integrate.[45] Black sees this exploration continue in the development of contemporary screen-based technology, particularly in the development of haptic feedback systems and the 'natural user interface', which attempts to create ICT devices that specifically work within embodied human action.

Black frames the differences between a tool, machine and interface in terms of "the degrees of agency and attention associated with their productive occurrence."[46] This agency, for Black, belongs to the realm of the human subject. He maintains that differences between the three interactions come from a difference in intention and conscious direction, saying that activities such as operating a smartphone require a substantial amount of both. The natural user interface is then positioned as working against this in assuming that this ability has arisen from the "innate, evolved abilities" of human bodies. The NUI field is interested in making ICT devices that are more quickly embedded into the body schema by specifically emulating and perpetuating the body as it interacts.[47] Robert Rosenberger demonstrates such an approach when he poses the use of "abstract relational strategies" as a tool for approaching (and developing) interfaces.[48] Although Rosenberger acknowledges these strategies as learnt rather than innate, such an

43. Gibson, *Ecological Approach,* 134
44. Jane Bennett, *Vibrant Matter: a political ecology of things* (Durham: Duke University Press, 2010), 119.
45. Daniel Black, "Where Bodies End and Artefacts Begin: Tools, Machines and Interfaces" in *Body & Society* 20 (2014): 32.
46. Black, "Where Bodies End," 37.
47. Black, "Where Bodies End," 45.
48. Robert Rosenberger, "The importance of generalized bodily habits for a future world of ubiquitous computing," *AI & Society* 28 (2013): 292.

approach allows a transference of understandings and bodily behaviours developed in using one device for a particular purpose to another device used for another purpose.The implications given for recognising such strategies as relevant include a shift in design strategy – away from interfaces that are assumed to be 'intuitive' and towards the acknowledgement and 'exploitation' of the strategies already recognised in the user group.

However, by fixing certain relations, which may then become defunct, Black asserts that "the NUI becomes something 'given' by the machine to a body." The problem with this approach arises because "there is no natural, originary dimension to these things that arises purely from within human bodies in isolation," rather these abilities arise from "the interaction of our bodies and material features of our environment."[49]

Black argues against the naturalisation of embodied human behaviours, saying that gesture arises from the relation between the body and the material. In the first instance, he maintains intentionality as a natural agency belonging to the human subject. When a challenge is raised to this construction in the form of a machine that 'gives' behaviours to the subject, it is argued against as being antagonistic to the subject, as restricting the generative freedom of human gesture. Thus, although specific gestures should be free to develop within the body-material world relation, the process of developing them should itself remain fixed within individual human intentionality. That is, Black maintains that the subject should control their individual encounter with the screenic device, not the device. Once observations of how people interact with devices are codified into the design of future devices, they no longer allow the subject this freedom. It is important to the relata-based analysis that, although the objects in question suggest certain behaviours and understandings, they do not force them. The subject alone chooses whether to use the object and to what end.

Expression and choice

The object, within this paradigm, expresses its potential for use, which the subject then chooses to take up. Affordance theory considers subject—object relations primarily in terms of use as this is the relation that allows subject primacy within this paradigm. In expressing its potential for use, the object materially expresses its role in the subject—object relation. It is in this sense that it affords certain uses, by calling them to the subject's perception. In regards to the ontology of the screen, then, the emergence of an object as a screen relies on the thing affording 'screenic' uses. In the sense that presentation as such is linked to the material properties of the object, there must be aspects of the form and behaviour of the material object that suggest 'screenness'.

49. Black, "Where Bodies End," 50; 56.

A matrix of screenic properties and impacts

This lattice belongs to the architectural envelope; a large, planar, punctured wall. I didn't put it there. It is fixed, I can't move it without destroying the enclosure, it doesn't respond to me. It is always there, it will probably outlast me. It forms part of my enclosure. I see it is made of apertures, repeated over the surface. When I look through it, I see a space like mine, things like mine, people like mine; all happening at the same time as mine. I can see this space, hear it, smell it.

I threw out my old CRT the other day, and got a big, flat-screen tele that sits on a bench in the corner. The television is still smaller than the lattice, less planar. It can be moved, with some effort I can push it around or pick it up. It is separated from the enclosure, it is enclosed with me. It is solid in a sense, I can't see 'through' it, there are no apertures. Instead, I turn it on and off when I want to. When it's on, I see a space like mine, I hear it. But I can't interact with it, it happens without me.

I pick up my new phone instead, I had to throw the old one out because it was too old. It is yet smaller than the television, it usually sits next to me on the couch but I carry it with me when I leave the room. I barely ever turn it off. It is manipulable. It responds to my commands and I can use it to interact, to vote on the show I'm watching. It is enclosed by me. The space I see through it isn't so much like mine, it is mostly text and still images. I can still see it and hear it, I can touch the screen, but its composition isn't the same, it has a different architecture.

If I wanted to connect the properties of screens to their impacts, I would need to make a comparative study, to consider different screens and how my experience of them changes. I might begin to categorise these changes, perhaps considering the form of the object, its behaviour in screening, my perception of it, the actions I can perform. I could then assemble these changes into a matrix to line them up, to draw connections between the changes. This would show a correlation, imply a causation, demonstrate an affordance.

In order to find what these are, links would need to be drawn between the form and behaviour of screens, and their uses, intended or otherwise. Were the project of affordance to be pursued in regards to the screen, it would be possible to compile a matrix of the physical properties of screens and their corresponding effects on 'perceivability' of impact. Such a list might consider properties such as scale, form factor, longevity, context, temporality and fidelity; and correlate these to uses such as enclosure, mobility, separation, manipulability, graspability. Any consideration of what the screen 'is', then, would be generalised from this understanding of its individual forms.

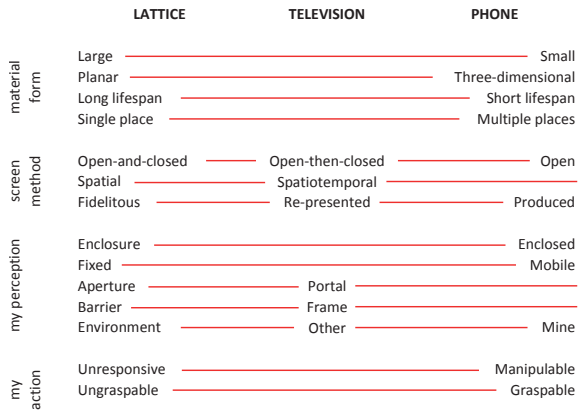

Fig 7. *Matrix of Screenic Affordances.*

I could draw a number of conclusions from such a matrix. I notice that the changes in physical form and my actions on screens happen in the same place. Perhaps these physical forms afford these actions – that large, planar screens do not afford graspability, that small, three-dimensional screens are manipulable and graspable. Likewise, I could say that the ability of the television to represent space affords its perception as a portal. Or else I could nest these into more complex affordances:

The scale of a screen is inherently bound in a comparison to the body. A screen that is much larger than the body affords a sense of enclosure or barrier. It becomes part of the 'environment' in the sense that it isn't easily acted upon. A screen that is similar in scale to the size of the hand, however, affords grasping and manipulation by means of being able to be picked up. Such a screen is more likely to become an extension of the body as it can be used in an tool-like way toward the world.

The ability of the television to turn on and off affords an interruption of the continuity of space and time. As temporality is intrinsically bound in spatiality, the introduced space is perceived as an 'elsewhere' and the screen as a portal to this space.

Could I then use these statements to design screens that did things, specific things, to the perceptions and actions of their user? Could such a list ever be exhaustive?

Properties and effects

The expression of the 'for' in these object properties relies on the screen as an ontological entity being somehow constitutive of its parts, of each individual example of a screen's materiality. A problem is presented here: the stronger the generalisation, the more difficult it is to retain the materiality of the object and the agency of the subject; and thus to retain the distinct sense of the object affected by the subject.

For example, screens are commonly discussed as boundaries to be transgressed. Jacqueline Jung notes that the materiality of the choir screen is pivotal to its ritualistic impact. She cites the screen's opacity and depth as responsible for defining two separate spaces and a boundary that "is to be crossed."[50] To use the language of affordances, the screen appears because an opaque and deep structure separates space and affords transgression. The ontological importance of screens as barriers and boundaries is more readily apparent in architectural screens such as the lattice, but other types of screens show similar affordances. Friedberg notes Romashyn's treatment of the window as "a boundary between the perceiver and the perceived."[51] Here it is the window's visual transparency and material rigidity, that create a boundary. She also notes Cavell's treatment of the cinema screen as a barrier to the world – here the temporal misalignment of the two spaces renders the viewer invisible to the world beyond. The idea of the barrier is entrenched in film theory; the act of transgressing the boundary of the screen by talking to the audience is codified by the term 'breaking the fourth wall'.

In this case, the properties of the material object become important only in their construction of the boundary, and it is clear that this boundary can be created using a myriad of physical properties. For the choir screen, these are opacity and depth; for the window transparency and rigidity. The condition of 'boundary' provokes the affordance of transgressing. In considering the screen in this way, the screen-as-object disappears again; present only as a condition, the boundary of a space. The role of the screen is to mark this space, to be apparent as a barrier that dissipates in the act of crossing. It is only with a small focus on an object or group of objects with a strong sense of cohesiveness that relata properties can be linked to effects. That is, affordances rely on individual encounter. Even then, this is not an exclusive domain – other properties may be linked to the same effects, and other effects to those properties. Moreover, because this interaction occurs on an individual scale, any generalisation of the properties discovered begin to displace the effect from the screen.

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50. Jacqueline Jung, "Beyond the Barrier: The Unifying Role of the Choir Screen in Gothic Churches," *The Art Bulletin* 82, No. 4 (Dec., 2000): 631.
51. Friedberg, *The Virtual Window*, 16.

Cross-coding the subject and object

In the analysis of hermeneutic mediation, it became clear that the transformation of perception possesses a specific structure, which consists of amplification and reduction… A similar structure can be discerned in the translation of action: artifacts invite particular actions while discouraging others or even rendering them impossible.

Peter-Paul Verbeek[52]

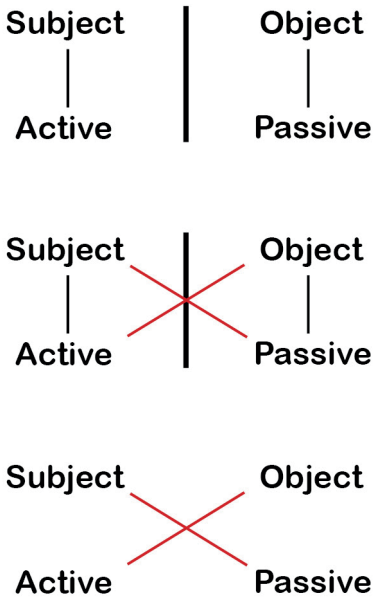

Fig 8. *Cross-coding 1.*

Am I an active subject, presiding over passive objects? Or does the object preside over me as well? Can it only *afford*, or can it *assert*?

Perhaps, instead of affording mobility, the phone *suggests* mobility. Perhaps it is not just that I *can* pick it up, but that I'm invited to pick it up. Perhaps I'm even persuaded, or forced. I might find myself holding my phone out of habit, without any intentional action toward it. Why did I pick up the phone, *my* phone, instead of something else? Did it make me?

I might find that its positioning in relation to my body, "always accessible, ready to hand,"[53] acts as more than an affordance. I can trust it, as it's always near me. It responds to my requests in predictable ways, it acts for me in a space I can't get to without it. It's by my side and on my side.

Trust, response, action. Is this a 'real' change, or simply a change in language? It might be that the object is no longer passive, that it holds a sort-of agency. Or at the very least that I perceive in it a sort-of agency. And, if I do, would I then begin to treat it as some sort-of other, something that I might have to negotiate with rather 'use'?

I acknowledge that my phone has a role in our relation. If I 'give' this role to the phone, though, it becomes less 'mine'. It is removed a little from the relation of 'use', just by means of expressing its role in this use. Is it still a screen, then, if it is removed from our relation of use?

The screen as object

Examination of the subject-object dichotomy within relata-based analysis reveals a doubling of the screen relatum into the nonmaterial screen that can act; and the individual, material screen that is acted upon. This internal split in the screen is needed to maintain the separateness of the dichotomous pairing along with the potential for a reciprocal relation. This split correlates to an embedded methodological difference between a screen as encountered and a screen as a generalised understanding. On the one hand, the screen is revealed as highly effectual – an effectivity which negates the materiality of the screen-as-relatum. The screen here is a nonmaterial container: a site, a repository, a mediator or, indeed, nothing but an effect itself. On the other hand, the screen acts as a suggestion of the use to which it could be put, triggering the subject into recognising potential needs and desires that could be fulfilled by the object. In this second case, the screen is considered materially; it is dissected into parts and expresses its role in the use relation by means of these parts. On the one hand, an effect without materiality, on the other hand a materiality without an effect.

In discussing the subject—object dichotomy, agency and materiality have reoccurred as important to the ontology of the screen. These two relations will be considered further in the discussion of the second dichotomy pivotal to understanding the ontology of the screen: the virtual—real dichotomy.

52. Verbeek, *What Things Do*, 171.
53. Kirsty Best describes the "handiness" of portable devices such as smartphones as being linked to their success in the marketplace. The devices are "technical actors," worn on and subsumed into embodiment relations so that they "easily become appendages." Kirsty Best, "When Mobiles Go Media: Relational Affordances and Present-to-Hand Digital Devices," *Canadian Journal of Communication* 34, no. 3 (2009): 404.

The virtual and the real

The second dichotomy I will discuss is that between the 'real' and the 'virtual'. I will begin by examining the screen's role in mediating the real and the virtual before establishing the difference between the real and the virtual as a question of materiality. I will then examine two roles for the screen between these spaces – as a separator and a connector – and what each of these implies for screen ontology.

Simulation and the threatened real

Jean Baudrillard notes the screen as having a distinct action on the 'real'. In the opening of *Simulcra and Simulation*, Baudrillard describes Borges' single-paragraph fable in which the Empire creates such a perfect map of itself that the meanings and effects of the *thing* and its *representation* collapse into a single form. Baudrillard is quick to point out that Borges' tale relies on a direct relation between the 'imagined' map and its 'real' referent; one that he believes no longer underpins reference in his time. Simulation, for Baudrillard, threatens the real rather than describing or abstracting it; it "threatens the difference between the 'true' and the 'false', the 'real' and the 'imaginary'."[54]

Simulation, for Baudrillard is a technology or force that works upon society by 'realising' the imaginary and consequently threatening the 'real'. The challenge that simulation poses means that the 'real' is unrecoverable, because the differences between this 'real' and the 'imagined' have been eroded through processes of realising the imagined, and vice versa. As Baudrillard puts it, "the impossibility of rediscovering an absolute level of the real is of the same order as the impossibility of staging illusion. Illusion is no longer possible because the real is no longer possible."[55] The dichotomy itself is what is at stake in this analysis – the loss of the other through which meaning is defined. Baudrillard anchors his conception of meaning in the determinate 'othering' of one term with another, and takes the oppositions between these others as granted – the real is graspable because it is not imagined; the imagined is graspable because it is not real. But importantly, both the real and imagined pre-exist any interaction between them. When the imagined becomes realised (a term that is read here as materialised) as a simulacrum, the distinctions between the terms are negated and meaning is lost: "Nothing separates one pole from another anymore, there is a kind of… collapse of the two traditional poles into each other… an implosion of meaning. That is where simulation begins."[56]

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54. Jean Baudrillard, *Simulacra and Simulation*, trans. Sheila Faria Glaser (Ann Arbor: University of Michigan Press, 1994), 3.
55. Baudrillard, *Simulacra and Simulation*, 19.
56. Baudrillard, *Simulacra and Simulation*, 31.

Baudrillard looks upon this lack of distinction negatively– finding it untruthful in the face of a predetermined reality. Importantly, 'realisation' is only possible because the imagined, as a relatum, holds predetermined or innate qualities that make it imagined. 'Realisation' must therefore be an act of force, something that intentionally alters the relata from its innate position. This act not only threatens the imagined by not letting it remain imagined; but it also threatens the real through the loss of its other – "the real… is no longer really the real, because no imaginary envelops it anymore."[57] The 'real' has lost the other by which it is defined.

Materialising the imaginary

So what role do screens play in this spatialisation and materialisation of the imaginary? Baudrillard discusses two types of screen media – TV and cinema – and takes a different view on their respective roles in simulation's collapse of meaning. I say 'screen media' here because, following McLuhan, Baudrillard does not separate the screen from the systems that perpetuate it, the objects that hold it, nor from the content that is shown.

Television, for Baudrillard, reaches the limit of indeterminability in the "indifferentiation of the active and passive." This same lack of differentiation is not apparent to Baudrillard in the more direct references of the cinema, which is said to retain an "intense imaginary."[58]

Baudrillard conducts a strange discussion of the material here. The TV, an object placed in interior space, enclosed and three-dimensional, presents content that bypasses the imagination and, along with it, any sort of material engagement; either with image or object. In place of this engagement, a form of hypnosis. In this sense, in a similar way to Debord's analysis, the material instance of a television is reduced to a support for the image, and the socio-political system that perpetuates it.[59] The cinema, by contrast, whose screen consists only of incident light projected onto a plane, becomes material and 'honest' by virtue of retaining engagement with the imaginary, and so retaining the simple image-referent relation that Baudrillard establishes as primary. Technological materiality is concisely set up here as unconnected to material effect.

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57. Baudrillard, *Simulacra and Simulation*, 2.
58. Baudrillard writes: "It is necessary to speak of the cold light of television, why it is harmless to the imagination… because it no longer carries an imaginary and this for the simple reason that it is no longer an image. By contrast with the cinema, which is still blessed… with an intense imaginary – because the cinema is an image. That is to say not only a screen and a visual form, but a myth, something that still retains something of the double, of the phantasm, of the mirror… nothing of this in the 'TV' image, which suggests nothing, which mesmerises, which itself is nothing but a screen, not even that: a miniaturized terminal that, in fact, is immediately located in your head." Baudrillard, *Simulacra and Simulation*, 31; 51.
59. Debord's spectacle makes material the immaterial; but any materiality that supports it is merely a support, not tangible in its own right. In this sense, "the tangible world is replaced by a selection of images which exist above it, and which simultaneously impose themselves as the tangible par excellence." Debord, *Society of the Spectacle*, 36.

Baudrillard makes this lack of definable materiality even clearer when discussing hypercommodities, where he also pulls this totalising relation into the screen *per se*: "no relief, no perspective, no vanishing point where the gaze might risk losing itself, but a total screen where, in their uninterrupted display, the billboards and products themselves act as equivalent and successive signs." The screen qua screen is now shown anywhere the image lands, and its tangible properties (as relatum) are almost indefinable, such that "the hypermarket cannot be separated… from the whole town as a functional screen of activities."[60] In this sense, it is the image that is active. The power of the image to turn anything on which it lands into a screen negates the real, as the real object (as plane or commodity) that preceded the screen condition is rendered non-present.

A negation

There are echoes here of the 'disappearance' of the screen that were found in the subject—object analysis. However, the process described by Baudrillard is more active process. It doesn't involve a perceptual mechanism but an active negation of material 'realness' by something nonhuman. The power to negate is given to the image, which overrides the materiality of that onto which it falls. The image negates the wall, the furniture object, the device by actively replacing their materialities with its own. The negation described by Baudrillard is well marked in the discussion of screens. McCarthy cites television particularly as central to debates about placelessness and virtuality in Modernity, with its impacts being described using terms such as "derealisation."[61]

Using this rhetoric, it is not only the screen-as-relatum negated by the virtual, but the condition of the material itself. The effects of the screen, then, are not limited to the subject—object relation, but are also concerned with spatial relations. The encounter now occurs instead through the screen and towards the spatial.

This distinction is, perhaps, an arbitrary one, as it could well be argued that space is a component of all interactions of people and things.[62] Heidegger's conception of Being involves an inseparable play of spatiality and temporality within the discovering of things within the world. Things, Heidegger states in his lecture "The Thing," are disclosed in the bringing-near

60. Baudrillard, *Simulacra and Simulation*, 75-76.
61. McCarthy, "From Screen to Site," 95.
62. Ihde's discussion of technological relations always involve three entities rather than two: technology, person, and 'world' or the person's external relations. This is the sense in which I use 'space' – spatial relations for the person are an external relation to the world, outside of an immediate person-object interaction. Heidegger speaks of three entities in his relation of perception: "the world and dasein and entities-within-the-world are the ontologically constitutive states which are closest to us." Martin Heidegger, *Being and Time,* 134.

of the world. 'Nearness', here, is not intended in the sense of a proximity in extended space, but in an involvement in the world. Spatiality comes about within a concerned involvement with the world and its references. However, the screen makes spatiality specifically at issue by marking a difference in its constitution, separating spatiality from personal involvement. That is, spatiality is not generated as part of an ongoing involvement in the world, but something that happens *to* a person.

Heidegger acknowledges spatiality being at issue with the screen in stating that "the peak of the abolition of every possibility of remoteness is reached by television."[63] The qualities of the television that allow this impact on space is its severance of spatiality from the human. Rather than allowing distance to be brought near in circumspection, the television presents distance as closeness. It thus eliminates distance – not purely by means of showing it as close, but by means of taking the process of nearing away from the person, eliminating their spatiality. For Heidegger, the space disclosed by the television is not properly spatial, because it does not allow a person to draw the world near, thus revealing its references. The space given by the television, and the space which Baudrillard discusses, exists as a relatum before the encounter between person and screen. Although not quite a Cartesian space, its pre-existence to the encounter is what allows it to be fundamentally shifted as a result of the encounter. A 'real' space is 'de-realised'. The spatial is split through this derealisation, founded on a pre-existing sense of space – into the 'real' and the 'not-real', or the 'real' and the 'virtual'. The fact of a difference between these spaces is then taken as granted.

Mediating the real and the virtual

The term 'virtual' is often used to refer to the image; a visual, digitally produced space. Rather than accepting the term in this contemporary usage, Friedberg follows the term's origins in optics, arriving at an understanding of virtuality as a perceptual condition involving materiality. She defines 'virtual' as "of, relating to, or possessing a power of acting without the agency of matter," noting that the term 'virtual' describes a representation that "'*functionally or effectively but not formally*' of the same materiality as what it represents."[64] The real, then *is* according to its inverse – the 'real' becomes that which possesses a power of acting specifically through matter.

63. Heidegger, "The Thing," 163. Nearing, for Heidegger, is a way of situating ourselves within our involvement. By drawing things near, things are revealed according to how they concern us. This reveals our concern along with the things, and contextualises us in relation to those things. It is in this sense that the spatial is generated – by drawing things near, a world unfolds as things distributed according to our concern.
64. Friedberg, *The Virtual Window,* 8, 11. Note here that Friedberg refers to the agency of *matter* rather than the subject *per se*. The concept of an agency that is decoupled from subjectivity is explored further in chapter two.

Colourmapper: creating visual distance

GP2Y0A21YK0F is a distance measuring sensor unit, composed of an integrated combination of PSD (position sensitive detector) , IRED (infrared emitting diode) and signal processing circuit. The variety of the reflectivity of the object, the environmental temperature and the operating duration are not influenced easily to the distance detection because of adopting the triangulation method. This device outputs the voltage corresponding to the detection distance. So this sensor can also be used as a proximity sensor.

Sharp Corporation[66]

The Colourmapper uses a fixed wavelength of light, at 870nm, to read my face. It looks at me, and converts the angle and position of what it sees to a voltage. It maps this voltage (which corresponds to what I might call distance) to a different wavelength of light, somewhere between 700nm and 650nm, and shows this to me. The Colourmapper doesn't touch anything, it takes some of the qualities of light and turns them into other qualities of light. Is the space it sees virtual?

When I look at the Colourmapper, the light bouncing off it *and* the light it emits is focused on to my retina by my cornea. The position of the beam, and intensity at which my different photoreceptor cells see it, is converted to a neural signal, which is mapped in my brain to such qualities as shape, colour, size. I know how far away the Colourmapper is because I can determine distance and size from these signals. But I also know how far away it is because it's telling me. Are some of these signals real and others not? Is the colour the Colourmapper displays happening in the real or the virtual?

Fig 9. *Colourmapper.*

The virtual, for Friedberg, is an "immaterial proxy for the material."[65] Friedberg relies on this distinction in materiality in order to show confluences and morphings between the screen and the window, both metaphorically and functionally. The term 'virtual' refers just as well to the image seen through the window pane as it does to the image appearing in cinema, or the image of a memory. The nature of this virtual image, and the way it interplays with the real outside of it, reveals the role of the screen for Friedberg. The screen—object, along with the window, again plays a mediatory role, this time between two spaces.

Difference and priority

The difference between spaces is more evident in certain types of screens than in others. The difference between the 'virtual' space of the computer screen and the 'real' space in which it sits, for instance, is quickly comprehended. Differences between the spaces to either side of a fly-screen hung over an open window, however, may be less readily apparent. It would even be questionable, in this case, whether either side of the screen would be called 'virtual' or whether other frameworks for discussion would be found. In each of these instances, however, the screen acts between two spaces. Given the variations in the differences between these spaces, in what terms can the nature of the 'virtual' be discussed?

To follow Heidegger's argument that the spatial can only be authentically revealed by drawing things near, the real must be considered primary. The screen, then, acts as a boundary, a thing that separates the space of embodied perception from the 'false' spatiality of the disembodied space. A different avenue of argument could be taken, however, to claim that the virtual has a higher perceptual priority. Such an argument could be based on Introna and Ilharco's comments about the screen being a call to attention, or on mechanisms such as flow, where the viewer gives themselves over to the virtual in a desire to be immersed.[67] In this case the virtual would become the primary relatum, and the role of the screen would be as a site of connection between the virtual and the real. I will now examine these two roles for the screen's mediation.

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65. Friedberg, *The Virtual Window,* 8.
66. Sharp Corporation, "GP2Y0A21YK0F," Data Sheet No. E4-A00201EN, Dec. 1 2006, 1.
67. Dant develops Raymond Williams' concept of the flow of broadcasting to the experience of television. He highlights the nested spaces of television – shots within scenes, scenes within segments, segments within shows – as creating a immersive flow from which it is difficult to retreat. Dant, *Television and the Moral Imaginary,* 87-93.

A spatial filtering: a hypothetical scenario

I am a receptor of discrete parcels of information; olfactory, visual, auditory, tactile, temporal. I am standing in a room. There's nothing here. I can see the space, I can hear and produce sound, I can smell the paint on the walls, I can touch them and they touch me back. I can move about the room freely, and all of this happens in real-time. I do something, and I get a response. I am unmediated.

But now I turn around and see a gridded lattice, like one that is used in a confessional or a bank. It's dividing the room in two, and I am on one side of it. It's a perforated physical surface, composed materially of repetitions of solid and void; it's permeable, but I can't get through it. Now, it has a few small apertures and I can see someone there by their movement. I can't make out their face, but I can hear them. It's cool on the other side of the room, there's a soft breeze coming through from there, it smells like the sea. Now the lattice has many large apertures, and I can see the person clearly. I wave at the person and they smile. I poke my fingers through the holes, but can't touch anything, just the lattice. I wonder why that person is there when I am here. Am I trapped? Are they trapped? Which of us is on the inside?

Now I see one of those apertures growing, the rest shrinking, a plate of glass appears. The room is now divided by a wall, and in the wall, a window. I can see straight through the window, of course, but it's a little brighter here than there and I see the ghost of my own reflection. My image is between me and the other person. I can't hear them well, either, though they seem to be talking in muffled words. It's a bit stuffy in here, so I open the window between us so I can feel that breeze again, and so we can talk freely. I guess I could climb through, now, but there doesn't seem much point – I'm more or less already there.

Separation: the barrier

Earlier in this chapter, I discussed the screen as barrier in terms of a subjective transgression, a potential for 'crossing' as an expression of agency. I'd like to explore this relation further now, focusing on the embodied perception of space in the nature of the barrier, rather than the subject's agency. Considering the spatial in terms of its embodied perception allows the screen to be examined in terms of its action in spatial filtering, particularly of the types and qualities of sensorial information allowed to pass through it. This supports a view of the screen as creating a perceptual distance.

As Giuliana Bruno notes in *Surface: Matters of aesthetics, materiality and media*, the term 'screen' came into usage in English in the fourteenth and fifteenth centuries to describe a furniture piece, a sheet of cloth or paper caught within a frame and used to divide space.[68] As a translucent divider of space, the screen is readily seen as a semi-permeable barrier. It is not solid and impenetrable like the wall, but offers sensorial permeability – the shadows of things behind, the sounds of others speaking, the smells of cooking. The screen here acts to filter the sensorial information available to the occupant from one side of the screen to the other, thus affecting their perception of space. This inherently spatial role of the screen can be used to explore media screens as well. James Ash, for example, in his examination of the computer screen as used in gaming, argues that screen-forms can alter the phenomenological field through their manipulation of spatial relations; including those of awareness and sensorial capacities. Dant likewise maintains that the perception of televisual space uses the "same perceptual apparatus with which the flow of the life-world is grasped."[69]

68. Giuliana Bruno, *Surface: Matters of Aesthetics, Materiality and Media* (Chicago: University of Chicago Press, 2014).
69. James Ash, "Emerging spatialities of the screen: video games and the reconfiguration of spatial awareness," *Environment and Planning A* 41 (2009): 2105-2124; Dant, *Television and the Moral Imaginary,* 101.

As I shut the window it changes again. The glass in the frame is replaced with LEDs, and between them they're showing the same scene that was in the window. There's my friend, and now I can hear them clearly, though some instrumental music is floating on top of their voice as if to match its emotional content. I ask a question, but it's a few minutes before I get an answer. Maybe they're talking to someone else? I try to focus on their face, but I can't bring it any closer – they remain at the same distance and all I see is pixels. I move back and stay still, trying to line up what I'm seeing with what is being shown to me. As I do so, the image changes, I can see close-ups of their pores, their hair follicles, the fall of their shirt. I feel like I'm touching them, but they don't look like they're being touched.

I turn around and see the same screen, and now I'm not sure if the other side of the room is in front of me or behind me. I walk over and take the screen off the wall, holding it in my hands as I sit on the floor. I notice that the room is just one room again, though now this thing is in it as well as me. It looks like my friend has done the same thing as me, I can see them and hear them sitting on their floor with their device. The lag must have gone. I type as I talk, each finger hitting the screen on a letter icon, forming a message. I feel like I could pick that person up with a pinch of my fingers, a tiny force to lift a whole person. They seem so far away. Are we separated or connected?

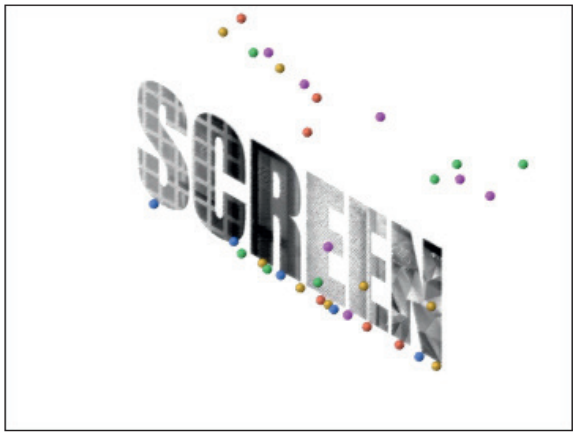

Fig 10. *A Spatial Filter*. [Video, 00:44].

Following Friedberg's definition, a 'virtual' space needs to fulfil two requirements: it must possess a power of acting, and it must be immaterial. However, the ability of the screen—object to mediate and recombine sensorial information affects the fidelity and quality of the space to the other side of the screen, inasmuch as it appears to a person on this side of the screen. In each of these cases, the screen's *material* effects these spatial changes, and so the screen-as-relatum must belong to the 'real'.

A material object filters sensorial information, resulting in a virtual space. Virtuality, then, is a sensorially 'reduced' space. Rather than look at the real and virtual as irretrievably divided, they could be seen instead as an issue of sensorial equivalency in the spaces across the screen. A perceptual distance is introduced by a lack of sensorial equivalency. As Black demonstrates in his discussion of peri-personal space, space is "perceived differently" if it cannot be "understood in terms of the possible movements and interactions that might take place within it." In Heideggerian terms, the reduced space would disallow "attending to what is near."[70]

This distance is enacted differently in different types of screen. The lattice still maintains a sense of the spatial possibilities of the other side. If a person could just step *through* the screen, they could enact movements similarly to their activities on their side of the screen. This set of possibilities, however, is not discovered through embodiment, rather it is overlayed on an understanding of spatial equivalence. The body that would interact on the other side of the screen is a projection. In this sense, the space behind the lattice is already virtual, because its distance requires a person's possibilities for action to be projected in possibility rather than discovered in the material.

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70. Black, "Where Bodies End," 44; Heidegger, "The Thing," 164.

Isn't it always going?

When I touch you, this is an event of separation and differentiation: tactility is the material event of such a dehiscence – of, precisely, the ethical differentiation of the I/Other.

Dave Boothroyd[71]

I need some sort of gap to recognise a difference in space. Touchbuzzer might just buzz all the time, how would I know? I can only feel it reciprocating my touch when I touch it. Our spaces are reciprocal, contiguous. What space is of Touchbuzzer and what is of me?

How is it a screen?

Camera obscura and other mechanical visual aids split the body off from a corporeal basis of sight while also claiming an undisputed truth value for what is seen through the apparatus itself.

Massey[72]

Is Touchbuzzer a screen? No. There is a distance between me and it, but I can only find this distance when I'm not using it. The second I touch it, the gap disappears.

Is Pitchmatcher a screen? Is Mover a screen? No. Each does something to my understanding of space and my abilities within it, but they seem to return on me rather than creating distance.

Is Colourmapper a screen? Perhaps.

I could say, at least, that Colourmapper *has* a screen. It produces spatial information and displays it visually, as a colour space. Would Colourmapper be so screenic if it displayed distance as a pitch, or a series of movements? Space may be acoustic and tactile and olfactory, but the virtual is almost certainly visual[73]. Perhaps screening is a visual medium because it is a spatial medium. Or perhaps, as Massey suggests, the screen made space a visual medium because it needed to open distance.

To counter this distance, and thus to make a projection of the possibility for effect more accurate, more and more spatial information is shifted to distance senses – primarily to vision. For example, windows allow multiple lines of sight, but no longer allow touch. The sense of touch is cut off at the window so that tactile information must be read through visual information. This visual sense of tactility is used well in cinema and television – graininess, moving focus, textural close-ups and the contrast of surface and depth are some filmic techniques used to trigger embodied responses similar to those triggered by touch, without the act of touch itself.[74] Distance is introduced between affect and effect, between *that* space and *this* one.

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71. Dave Boothroyd, "Touch, Time and Technics: Levinas and the Ethics of Haptic Communications," *Theory Culture Society* 26 (2009): 342.
72. Lyle Massey, *Picturing Space, Displacing Bodies*, (Pennsylvania: Pennsylvania State University press, 2007), 71.
73. Introna and Ilharco state that "the screen is first and primordially involved in seeing, watching, perceiving with the eyes," and connect this seeing to the "ontological primacy of seeing" as a way of spatialising the world. Introna and Ilharco, "On the Meaning of Screens," 68-9.
74. Laura U. Marks, *Touch: Sensuous Theory and Multisensory Media* (London: University of Minnesota Press, 2002), 7-10.

Touchbuzzer: haptic hapticity

‘The skin’ can no longer be presumed to have as its primary reference the biological-physical epidermis ... rather, it should be rethought as the inter(sur)face of sensibility; of *touching* itself ... the term ‘skin’, I am suggesting, should be allowed to continue to stand as the name of the site wherein *the event* of contact takes place.

Dave Boothroyd[75]

Fig 11. *Touchbuzzer.*

Touchbuzzer touches me as I touch it. I can be extended into the space beyond my skin, but only until I find a surface which belongs to another. This new surface might be my skin and the other’s skin at the same time – this is our boundary, one on either side. It happens at the edges of my space.

The razorblade scene in Luis Buñuel’s *Un Chien Andalou* touches me too, so violently that I cringe. But I don’t touch it, because it’s too distant from me. Can it be in my body but not in my space?

If the screen-as-relatum acts as a marker that splits the 'virtual' from the 'real', then, it does so in the sense of creating perceptual distance. The object of the screen exists in 'real' space as material, and creates distance by means of its materiality. As the distance between the two sides of the screen increases, a person needs to project themselves further to retain a connection between the spaces. This is not a task undertaken by the screen, but one which is undertaken by a person, to counter the distancing effects of the screen. As perception is focused more on the spatial difference, the screen, in creating this distance, disappears.

The screen separates these spaces, but cannot be defined through them. As Martine notes, "the boundary that separates… is intelligible only in relation to the separation it is taken to denote. It is not itself something that has the definition of either of the terms that it stands between."[76] The boundary cannot be taken out of its context and retain its meaning as boundary. It must be a boundary *between* things. As a boundary, the screen must be between the real and the virtual. The 'real', then, refers to the surrounding material environment, and the 'virtual' to the distant space being drawn in to this environment through immaterial means. The screen—object is held in stasis between the two.

Suture: the frame

Having shown the screen to disappear as a barrier that separates spaces, I will now consider its role in connecting spaces. Although these two roles may seem a contradiction, both can be seen in the definition of the screen.

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75. Boothroyd, "Touch, Time and Technics," 338-9.
76. Martine, *Indeterminacy and Intelligibility*, 55.

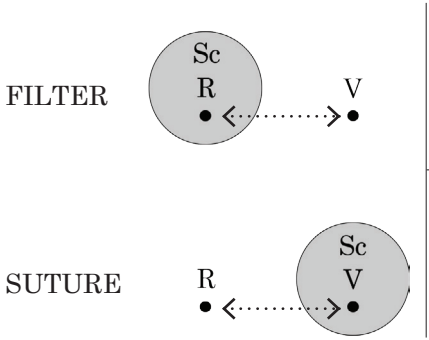

Fig 12. *Filter and Suture.*

In the sense that is acts as a barrier, the screen marks a difference in space: an 'inside', in which the subject dwells in the phenomenological sense, drawing things near; and an 'outside' from which this process is restricted. In other words, two sides are present when encountering a screen – *this* side, and *that* side, the side that is screened. A lattice may separate *this* side from *that* side, but a smartphone brings *that* side to *this* side. Separation and connection are both modes of contextualising spaces.

Friedberg marks the condition of separation in the spatial device of the frame. She comments that the screen's materiality is encountered as the fixed frame, which marks the delineation of a moving 'view'. This delineation results in "a separation- an 'ontological cut'- between the material surface of the wall and the view contained within its aperture."[77] Similar ideas of separation were encountered when discussing the boundary, and a similar rhetoric of inside and outside can be applied to the frame. However, the frame implies a different spatial relation. A barrier may not necessarily have perceivable edges, it presents in its ability to restrict the body. A frame, by contrast, is recognised in its edges – it is a circumscription, a complete bounding of planar space. The space bounded by the frame, in this sense, is held within the frame. When the screen appears as a frame, the virtual is seen *in* this frame. Two conflicting sense of 'inside' are presented by the screen as frame: the inside in which the person dwells (the 'real'), and the inside of the contained space (the 'virtual). The role of the frame is to contextualise these spaces, which both appear as an inside, and so both also correspondingly an outside.

In this second role, the frame acts as a fixed, 'real' context to an introduced 'virtual' space that is otherwise discontiguous with its 'real' surroundings. Connolly likewise notes the role of the screen-as-frame in galleries, noting that it might appear to "contain the image so that it is read 'centripetally', like a painting," or else to "connect the image to the gallery space" introducing a blurring or "spilling over" of the introduced space into to the viewing space of the gallery.[78] As a point of separation, the screen contains the virtual inside itself; as a point of connection, it transposes new 'outside' spaces into the 'inside' of a person's experience.

The frame's contradictory division of inside and outside make the screen a device of inclusion and exclusion. As Introna and Ilharco comment, the screen has "frames and edges that allow us to refer to that which is 'on the screen' as opposed to 'off the screen'," including and excluding certain spatial possibilities.[79] For this reason, the frame's transposition can never be complete.

77. Friedberg, *The Virtual Window,* 5.
78. Maeve Connolly, *The Place of Artists' Cinema: Space, Site and Screen*. (Bristol, UK: Intellect Books, 2009), 23-24.
79. Introna and Ilharco, "On the Meaning of Screens," 68.

Cross-coding the real and virtual.

When a surface condition is activated in this way on visual planes, it changes our notion of what constitutes the support of the image and its way of siting a medium. I want to demonstrate that this new form of materialism initiates a major transformation. In surface encounters, novel dynamics are generated, including an innovative form of materiality that is light, diffuse, flexible and permeable.

Giuliana Bruno[82]

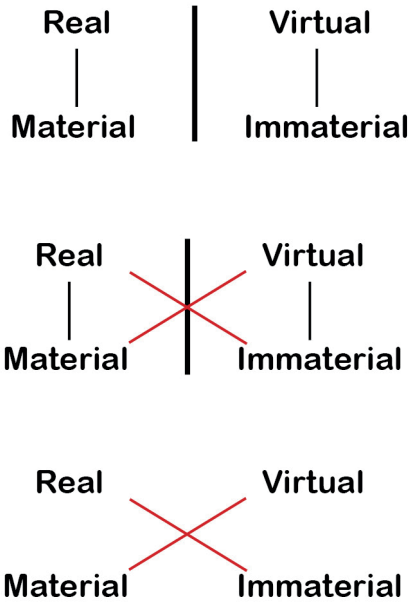

Fig 13. *Cross-coding 2.*

Is the virtual an immaterial realm, unable to be touched? Or does the virtual *have* the materiality of the screen?

I can talk about the real as the space to my side of the screen, and the virtual as the space to the other. When I'm texting on a phone, the differences between the spaces are obvious. They are composed of different architectures and outcomes. I can type and send a message, but I can't *materially* interact with that space. I can't use my body to pick up one plane of text and place it in front of another.

But I can't do this behind a lattice either. I recognise that I could, perhaps, shuffle things around if I could get through to that other side. But I *can't* get through, that action remains only a possibility. And if I did somehow get through, wouldn't that side be my side, and this side the other side? Is the other side of the architectural screen also only a space of immaterial possibility?

Perhaps, instead, I can talk about the real, material object of the screen and the virtual, immaterial space it presents. These two are obviously antagonistic – the virtual image overwhelms the 'real' phone so that it disappears in perception, it becomes a frame. The virtual violently negates the material screen.

I hand my phone to a friend to show them a video. If the image hijacks the material screen, what am I handing over? Is it the image that is having material effect in the hand of my friend; being turned about, swiped over and discussed like a tool? As the screen is touched, is the image touched also? Is she materially interacting with the virtual?

Any connection between the two spaces works to enforce their separateness – two relata cannot be connected unless they exist separately to one another to begin with.

The impossibility of existing together can be acknowledged when considering the relation between the frame and viewing. As Friedberg writes, "the moment that the spectator becomes aware of the frame, the joissance/pleasure in an image is lost, reduced to an awareness of the enunciative presence of the apparatus."[80] As soon as the screen relatum is revealed in perception as a frame, its transposition of space loses effect. The relation between a person and a 'virtual' space becomes a relation between a person and a material screen; perception is reoriented to the 'real'. In so doing, the screen is revealed as connector, and the separateness of the two spaces becomes revealed along with the connection *per se*. The frame only works as a frame whilst it remains negated by the virtual space.

The description of the screen as a frame again suggests that it has no content of its own. The role of the screen as frame is to act as a 'suture'[81] – to transpose a space and stitch it in to the 'real'. The event of stitching is recognised at the border of the introduced space, at the frame. Importantly, this spatial disruption seems to conflict with and leverage off the screen—object in a distinct way. The 'virtual' content is discussed as being of a higher ontological importance than the 'real' object. The virtual, as the primary relata, is the focus of the analysis. The materiality of the object itself is only important in the sense that it supports the virtual, and so the screen-as-relatum cannot appear in perception. As soon as the screen reveals itself as relatum, its support of the virtual space fails.

The 'virtual' also becomes split, with implications for understanding the screen. The 'virtual' can be othered by the screen object as 'real' material, in which case the 'real' is considered as the material realm and the 'virtual' as the immaterial. The line between the real and the virtual then becomes a question of materiality. However, the 'virtual' can also be othered to the 'real' space, or the space to 'this side' of the screen, in which case the 'real' becomes a matter of embodied interaction, and the 'virtual' of a representational engagement. The line between the virtual and the real then becomes one of agency, of bodies interacting with and manipulating space.

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80. Friedberg, *The Virtual Window,* 81.
81. Suture theory arose in the 1960s and described the importation of a the film's space into the immediate spatiality of the viewer, particularly the disjunctions between shots and perspectives. Friedberg, *The Virtual Window,* 81.
82. Bruno, *Surface,* 5.

Bridging dichotomies

Relata-based analyses of the screen present a series of problems, some of which were demonstrated in the discussions of the subject—object and real—virtual dichotomies above. The screen's unique position in raising these problems becomes particularly clear when considering theories that attempt to bridge these dichotomies. Examining these bridging strategies can reveal the commonalities that lie behind the differences. I would like to finish this section with a discussion of strategies used to bridge screen dichotomies, first for the subject and object, and secondly for the virtual and real.

In the discussion of the subject and object above, the two relata had to be held apart in opposition whilst remaining connected by a relation of agency. This separation resulted in an analysis that could only find the screen as agential in a de-localised sense, as a force of technology rather than a material instance. On the individual scale, screens were defined by their use, by being acted upon. The screen, in this case, formed a question about the constitution of the subject and object. Peter-Paul Verbeek challenges such changes of scale in regards to technologies. Verbeek holds that, as technologies mediate both perception and behaviour, they play a critical role in the determination of the subject. That is, "a technology does much more than realise the goal toward which it is put," it shapes the actions and perceptions of those using it.[83] Verbeek, in line with Grosz, Coole and others, begins to remap agency as a relation between things rather than a property of the subject.[84]

Such an approach opens the possibility of mapping effects of individual screen forms on human behaviour and perception, similarly to the affordance framework, but then allowing the object to express these effects as agencies. The language of the affordance framework clearly preferences the primary relatum of the subject. Nevertheless, there is some subtle sense of agency attached to the object in the way it affords, allows or communicates certain uses. It would not be difficult to revise the language of the affordance framework to make this agency more accessible, though it might begin to threaten the parameters of the relata-based analysis. Verbeek suggests that objects might "invite" and "inhibit" behaviours rather than simply afford them.[171] Verbeek's active language might, however, be pushed further – perhaps individual screen objects could be persuasive, or even forceful, within individual relations.

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83. Verbeek, *What Things Do*, 43.
84. Agency as a relation will be discussed more thoroughly in chapter two, along with the work of Coole and Grosz.
85. Verbeek, *What Things Do*, 171.

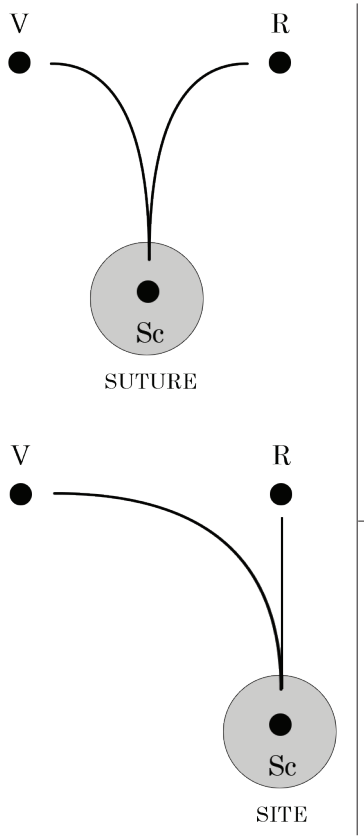

Fig 14. *Suture and Site.*

Nicholas Nova, Katherine Miyake, Walton Chiu, and Nancy Kwon begin to provoke these sorts of object-based agencies in their project *Curious Rituals*,which catalogues behaviours developed with screen forms. These behaviours range from personal interactions with devices, such as "thumb texting" and "the prayer reader," through to group behaviours such as "the periscope." Nova et al have two aims: to question the role of the body in the virtual; and to show that behaviours aren't always designed, but arise out of uninstructed interactions.[86] In cataloguing and naming a variety of everyday behaviours, Nova et al show various *things* as the common point of these actions. That is, people don't intend these actions they undertake with screens, but there is something about bodies and devices that induces these common actions. Kirsty Best also suggests a repositioning of the affordance framework in her discussion of media on mobile devices, saying that "a technology's affordance is a relationship it has with its users, rather than a static trait."[87] In this respect, an affordance isn't a property of the object *per se*, but something that arises in interaction. Best uses this particularly relational view of affordances to examine people's choices in using or not using the technological capabilities of their smartphones, showing that these uses are always contextualised within the (particularly social) worlds of the 'user'.

These studies start to break the dichotomy between the subject and the object by focusing on the object's role in agency. They look with more focus at the *unintended*, and in so doing make a shift from a conception of agency that arises from the intentional subject toward a conception of agency that arises within a context, from between a subject, object and world. They explicitly look at the excess of the 'for' relation, that which slips outside of the intent of designer or user. Similar studies can be found in discussion of the real and virtual. The previous section found that the ideal of the frame, ontologically and materially, is its disappearance. If this sense of disappearance is pursued materially, allowing the frame to thin until almost invisible, the screen ceases to frame an introduced space and becomes instead a *site* for the virtual. As a site for the virtual, the role of the screen is to locate the virtual within the real. Introna and Ilharco discuss the screen as a mode of presentation, lending 'presentation' a spatiality in terms of "making present" and "locating activity." The screen makes things present, it locates them within involvement, and in this way it sites the image. But it is unclear how, as a site, the screen can locate both itself and the virtual. Bruno explores the material of the surface as "a form of dwelling" that "can become a site of screening and projection." The surface is presented as a location, "a form of siting and a space for the materiality of media," and in this sense it is acted upon by the virtual, "plastically activated, and sculpted" by the immaterial.[88]

86. Nicolas Nova, Katherine Miyake, Walton Chiu, and Nancy Kwon, *Curious Rituals: Gestural Interaction in the Digital Everyday*, accessed February 23, 2016, https://curiousrituals.files.wordpress.com/2012/09/curiousritualsbook.pdf; 7-9.
87. Kirsty Best, "When Mobiles Go Media," 403.
88. Bruno, *Surface*, 94; 108; 101.

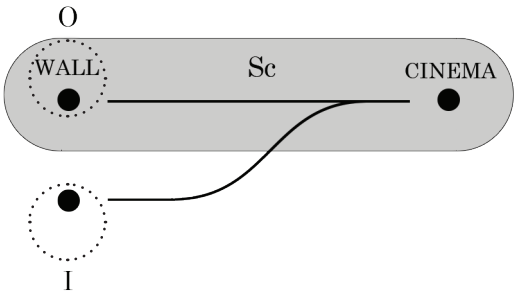

Fig 15. *Cinema.*

Bruno is interested in the materiality of the screen, but takes this materiality in a specific way. The screen is shown in her text as a sum or overlay of the two materialities – a site plus an image – which together form a material surface. As Bruno writes, "this is why a prefer to speak of surfaces rather than images: to experience how the visual manifests itself materially on the surface of things, where time becomes material space."[89] Unlike Introna and Ilharco's analysis, which takes place before the virtual reaches the screen and is separate from the content of the image, Bruno's analysis happens with and after the virtual, as this is, for her, where the two form a material entity. Before the image reaches the surface, the surface is a materially different entity – a wall, perhaps, or a façade or canvas. Once the image reaches the surface, it overlays its own (im)materiality, which creates the material screen. The site is thereby integral to the materiality of the image – the screen arises as a confluence of site and image. The screen, as a site, is not entirely displaced by the image. Instead, a new entity is created between the screen—object and the image.

Modes of projection, particularly cinema, provide one of the bases for Bruno's establishment of the screen as a site. Changes in how images are projected indicate an increasing familiarity with the composite of virtual and real materials. The spatial organisation of the cinema theatre shows a distinct ordering of the 'real' in opposition to the 'virtual'. Early cinemas reacted to the sense of distance introduced by the screen—as—barrier with attempts to ritualise the 'journey' between two distinct places. Amir Ameri comments on these attempts, saying that "the two [spaces] have to be conceptually, and for that matter, spatially and architecturally kept apart." Architectural emphasis on the threshold, the exotic treatment of decoration in the theatre (or conversely, the design of the theatre room as 'void'), all attempt to place the experience of watching a film at "a marked experiential distance from reality."[90] A boundary is maintained between the film and the 'real' using the cinema itself as a delineation between the introduced space and the space of everyday experience. In this sense, the architecture of the cinema acts as a frame that a person can step inside. The frame is echoed in this three-dimensional sense by the negation of its materiality within – acoustic management, colour schemes, sight lines, comfort and etiquette are all managed towards the disappearance of the cinema as a 'place'.[91] The architecture of the cinema is a shell, a three-dimensional frame which contains an introduced space.

89. Bruno, *Surface*, 3.

90. Ameri, "Imaginary Placements," 81; 82. Ameri notes that, with the introduction of sound, the edges of the screen could no longer be a suitable frame for the movie, as the experience of cinema filled the space acoustically. He positions the architecture of the cinema itself as fulfilling this role. Ameri, "Imaginary Placements," 89.

91. The immobilisation of the body is often discussed as a technique that encourages immersion in the image. Friedberg quotes Robert Smithson in this regard: "going to the cinema results in an immobilisation of the body ... All one can do is look and listen. One forgets where one is sitting ... Impassive, mute, the viewer sits." Friedberg *The Virtual Window*, 149. Ameri remarks that, after the introduction of sound to movies, cinema design was to intended to create "a featureless path to an imaginary destination" to support this experiential immersion. Ameri, "Imaginary Placements," 89.

These strict boundaries between the virtual and the real are not, however, maintained in some recent projection techniques. Three-dimensional projection mapping challenges the separation of the real and virtual by dissolving the screen as plane. Projects that use projection mapping rely on the volume and texture of the object to create new materiality. Rather than overriding the empty plane of the screen with a planar image, projection mapping distorts the image in response to the object it will fall on to, creating the overall effect of a single-context confluence between material and immaterial.[92]

Particularly interesting in this regard are projects such as 1024 Architecture's *Perspective Lyrique*, which projects on to the architectural façade of Théatre des Celestins in Lyon.[93] The building, which formed the screen in this installation, has a strong materiality as a static and familiar object in the public environment. Layering onto the façade an image that specifically dissolves the building envelope questions this familiar materiality. The imagery stretches and morphs the façade of the building into a singing face, which the public can then control by singing into a microphone. The 'realness' of the building is counteracted by the stretching image, which at the same time responds directly to the building. Once in its state as a face, the image also responds to people, drawing connections between their and the building's actions in space. Once the sequence is finished, the building returns, unharmed. The screen, then, effectively 'disappears' once screening is no longer implemented. The suture of the virtual and real is so effective here that it is difficult to say where the screen-as-relatum might exist. The screen disappears into the building, becoming a particular expression of that building – wall—as—screen, façade—as—screen. The materiality of the thing remains with this 'other' – the wall is hard and opaque whether or not it is catching projected imagery, and so hardness and opaqueness belong to the wall, not to the screen. But, following Bruno's equation of the screen as site, the materiality of this other affects the material quality of the screen. The screen coincides with the object, but the object exists outside of the screen condition.

The screen-as-site is an inversion of frame. The image is not 'inside' the frame, but acts as a skin, an outside. Bruno refers to this skin as a materiality that has "morph[ed] culturally, transmitting into another medium."[94]

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92. Anke Jakob; in "Light—Virtual Cloth and Digital Textile," *Textile* 6 no.3 (2008): 254-260; discusses the interplay of material and immaterial surfaces in projection as "the employment of light in combination with material and texture influencing the shape and character of surfaces, garments, and buildings."
93. 1024 Architecture, "Perspective Lyrique," December 2010, http://www.1024architecture.net/en/2010/11/perspective-lyrique/.
94. Bruno, *Surface*, 7. The screen in Bruno's analysis is a form of materialism in itself, an "innovative form of materiality that is light, diffuse, flexible and permeable." Bruno, *Surface*, 5. Laura U. Marks likewise defines haptic visuality as a "translation… from one sense modality to another." Marks, *Touch*, ix.

DISAPPEARANCE AND NEGATION: ONTOLOGY AND THE SCREEN-AS-RELATUM

The issues raised in the discussion above are all based on the screen and its actions and meanings to different contexts at different scales. Despite their potentially conflicting natures, they are all indicative of screen-ness in some way and can, together, reveal something about the role of the screen-as-relata. This analysis began with a doubling of the screen to present as a relatum in two distinct ways: the object that opposes the space of the screen, and the object that opposes the person. In the first case, the 'object' was understood as a physical, material residue and discussed in terms of the *virtual* and the *real*. In the second case, the 'object' was that which stood against subjectivity, and the screen was discussed in terms of the *object* and *subject*.

This chapter has repeatedly come across disappearance and negation as central to the screen—as—relatum. It is not, however, the screen that enacts this disappearance or negation, but the screen as relatum which disappears. Rather than any material property of the screen being put to use, it is its material disappearance – its condition as a frame or boundary – that is put to use. As a container, the role of the screen is to hold and express social forces such as attention, mores and community standards. As a material tool, the role of the screen is to be put to use by a person. As a barrier, the role of the screen is to separate; and as a frame, to connect. These roles hold the screen as a boundary between other things. Constructing the screen as a boundary causes a problem for understanding the screen as relatum because, as Martine notes, "a boundary does not have the character of the thing it bounds any more than determinacy has the same character as particular determinations."[95]

In finding the screen as a boundary, the screen relatum is hidden rather than disclosed. The ontology being described is that of what arises in perception – the space or the person, not the screen. For this reason, the screen is not ontologically accessible as relatum – it is defined as a void, a line or an absence. The role of the screen as relatum is not its own role, but is an external force attributed to something else – the social, the intentionality of a person, the spatial, an image. The ontological basis of the screen, then, negates the screen-as-relatum. It is this something else which has relational value, and so the screen cannot appear as relatum. Moreover, with the negation of the screen, the ontology of the screen is called into question – if nothing other than the social or the spatial is seen, how can the screen appear in perception?

95. Martine, *Indeterminacy and Intelligibility*, 49.

Debord hints at the mechanism by which this might occur: the screen and the image 'realise' these external forces in the sense of making them tangible, locating them within everyday involvement.[96] Though Debord draws the conclusion that the effects of a screen are contingent upon its ability to perpetuate a 'realised' social space, this is only part of the screen-relata's role. He glosses over the screen's *making tangible*, the process of realisation. The screen acts as a support for these spaces, a 'real' locator for something intangible, and as such must itself be tangible. Although the materiality of the screen—object is often lost amongst a concern for the 'virtual' (the space that is being anchored by the frame or site of the screen) the 'realness' of the object is inextricably bound within its role as relata. In other words, the screen anchors 'virtual' spaces, but it does so only by virtue of *being an anchor*, a material, 'real', thing. This is the crux of a paradox in regards to the screen-as-relatum: the screen relies on a material instance to locate virtuality and subjectivity within the everyday, but this instance must dissolve in order for these entities to be properly located. An unusual ontology surfaces: the screen generates its own other.

The screen acts to contain or divide, an action that generates and expresses a difference between entities. This difference occurs as dichotomous pairings: the subject against the object, the real against the virtual. The screen is, in this first instance, implicated by its role in splitting these pairs, by making them perceptually available. But this role tells us nothing about the screen *per se*. Rather, it tells us about the relata of the created opposition: that the real is real because it is not virtual, and vice versa. To discover more about the screen as relatum, it needs to be referred back to its relation in a way that makes it perceptually accessible. This means referring to the screen in relation to the entities it generates: the screen against the subject, the screen against the object, against the real, against the virtual. The screen, however, cannot be the primary relatum in this relation, because it is always the effect that is of interest. The screen is always the 'other' to the virtual, real or the subject.

The tension between what the screen is for and its materiality is important to understanding the ontology of the screen. The difference between the screen's materiality and use and that of other objects becomes clearer if this role of the screen is compared to a tool-like relation.[97] In the example of the hammer, the materiality of the thing and its 'for' relation gives us an 'out' for the relata-based analysis. The hammer is 'for' driving a nail. This relation depends on a variety

96. Debord writes that "the spectacle cannot be understood either as a deliberate distortion of the visual world or as a product of the technology of the mass dissemination of images. It is far better viewed as a *weltanschauung* that has been actualized, translated into the material realm a world view transformed into an objective force. Debord, *Society of the Spectacle,* 4.

97. Heidegger uses the example of the hammer in *Being and Time* to explicate the ready-to-handedness of tools. Heidegger, *Being and Time,* 97-101.

of nested relations, for example, to the hand and to the nail. In each of these, there is a direct correspondence between the hammer as it others and the hammer as it is othered. The hand, as opposed to the hammer, is soft, is flexible, can grasp; the hammer, as opposed to the hand, is hard, rigid and graspable. The nail, as opposed to the hammer, is small, light and sharp; the hammer, as opposed to the nail, is large, heavy and blunt. The relation is lineal, from the person to the hammer to the nail. In focusing on each opposition within this relation, the relatum of the hammer can be identified by its useful properties: it is hard, rigid, graspable, large, heavy, blunt. Like the screen, in defining the hammer in opposition to the nail, or the hand, different relata are revealed. Unlike the screen, these relata are not mutually exclusive.

According to the parameters of the analysis, the screen splits space into the real and the virtual. Rather than a lineal relation, a triad is formed in which the virtual others the real, and the screen others both the virtual and the real. This relation cannot be closed. For example, if the real is defined as 'not-virtual', and the screen is also defined as 'not-virtual', the screen must coincide with the real. Likewise, if the virtual is defined as 'not-real' and the screen as 'not-real', the screen must coincide with the virtual. In trying to establish the linear relation required by the analysis, the two screens (the not-real and the not-virtual) must be conflated. Despite being situated in the same perceptual stimulus of the relatum, the material object, the properties of the two screens as relatum are at odds with the other.

It should be evident from this discussion that, in each case, the screen is defined as relatum in relation to what it is *not*, but these others were revealed *by* the screen in the first place. The screen is *not* real and *not* virtual, but if real and virtual are opposites, the screen is unable to be defined as relatum in this relation.[98] The screen has nowhere to go – it cannot be defined as an otherto the real, and it cannot be defined as an other to the virtual. Thus the screen is called out of the relation – it disappears or is negated. Moreover, it disappears into or is negated by something that it itself made perceptually available as an entity. The screen thereby establishes a gap. But this is not in the sense of a separation – a gap *between* the real and the virtual or the subject and the object as predetermined entities. Rather it is a gap *within* – within the system of meaning that generates these as alternatives in the first place. The separations between the subject and space, between the subject and the object, and between the real and the virtual are

98. This problem is characterised by Martine in his discussion of determinacy: "If water is to become determinate, there must be some Other that can give 'not-water' a meaning. But if we try to turn fire into such an other, and suppose that we have discovered the internal structure of fire by characterising it as 'not-water', we will encounter the sort of problem discussed previously. Fire… then, must be both something in itself and 'not-water' to allow further development of the account… must appear both as something determinately in itself and something indeterminately but meaningfully distinct from water." In defining the screen by what it is not, the definition only references itself. Martine, *Indeterminacy and Intelligibility*, 56.

Towards, not away.

Everything that we say about the objects that we had initially taken to be prior calls our attention to the relations in which those objects stand to the other objects around them. We find ourselves having to describe these 'prior' things by means of relational frameworks of one kind or another, and in the process, the possibility of seeing the relations themselves as prior emerges as a serious one.

Brian John Martine[99]

I divided the screen into parts, and I found that the screen wasn't *in* any of these parts. This was hardly surprising, as I had only a few parts, and they didn't add up to a whole. My inexhaustive approach ensured that my project was incomplete. I wondered, at the beginning, whether these little cuts would send my relata flying away from one another, overpowered by the force of the opposition. Would the real and the virtual stand on their own, separated? Would the screen and I bear off in opposite directions, becoming present-at-hand entities for observation?

It seems, rather, that we all collapsed in on one another. The *Behaviour Boxes* began to express their roles in our relation, and in doing so, gained a kind of alterity. This wasn't the alterity of an object that is merely the focus of my intentionality, though, it was the kind of alterity that *gained* my attention. I recognised in it a slight agency. This agency did not seem so different to mine.

In gaining my attention, the *Behaviour Boxes* refused to disappear into the 'virtual'. Their virtualities, the non-material ways in which they expressed space, appeared with a sense of materiality when housed in these recalcitrant boxes. These expressions of space resulted from and were held by material things, and they seemed no less virtual that the mechanics of my sight. Our spaces did not seem so different.

Perhaps it is not so much that the project is incomplete, that more parts would reveal the screen. Perhaps it is more that the project is, by nature, incompletable. If so, the relation between these relata, the ways they all come together, is stronger than the opposition between them.

a function of the analysis rather than an act of the screen. The screen fits awkwardly into the relatum-based framework, exposing the restraints of this understanding. It could be argued that this gap is opened within every interaction between a person and a thing, that there is always something that escapes the relatum. This is, of course, true. What is unique to the screen, however, is that it makes this gap ontologically available. This gap can be recognised in the desire to provide transgressive methods of pulling the subject and the object, or the real and the virtual, together.

99. Martine, *Indeterminacy and Intelligibility*, 4.

ASSUMPTIONS AND CONCLUSIONS

Terms like 'separation' and 'connection' reveal a role for the screen in producing a gap. The gap produced is experiential in that it exists as a difference between things – between the subject and the object, the real and the virtual. However, it is also a function of the divisions put in place by the analysis – the tendency towards dichotomisation and the stress of difference over commonality. The bridging mechanisms mentioned above act in a certain way towards the gap opened in analysis. They begin with a separation: a barrier between dichotomous pairs. They then transgress this separation in the form of connection, to show that the real and the virtual, for instance, can be related to one another spatially, as in the case of the frame. The act of connection is then covered over so the separation is almost invisible – so that it no longer possible to see where the real ends and the virtual begins.

The bridging techniques introduced to blur the lines between the dichotomies rely on the dichotomy itself to create the bridge. They acknowledge the gap between the real and the virtual, the subject and the object in attempting to bridge it using its own terms. To talk about a transmutation of materiality is to think first of materiality as belonging to the 'real'. Likewise, to talk of haptic visuality is to think of touch as belonging to the skin. Such approaches do not seem to get around the primacy of the subject, or the real; or around the negation of screen-as-relatum and what it *is* that is negated. That is, the gap can never be closed, it persists during interaction as the basis of the interaction.

The outcome of relata-based assessment is intrinsically dependent on the way its assumptions were crafted. Relata were found within interaction. These relata were given relation properties based on assumed relations, most particularly the relation of use. If the relatum properties are relational, and the set of possible relations is defined by these properties, the analysis becomes caught in a logical loop. The relation and the relata are competing for primacy in perception. This does not pose such a problem in the tool relation, as the materiality of the tool is often directly connected to its use. This suggests an exit from the relata-relation loop, as it gives a relational understanding of the object that can be located within the object itself. But in the case of the screen, the use relation isn't a matter of the screen's materiality, but its behaviour in opening and closing space as a barrier or connector. As a result, the screen relatum disappears into the spatiality it opens.

Martine notes that "for centuries now, we have been accustomed to assume that things occupy a status both ontically and epistemically prior to that of *relations among things,*"[100] and this assumption leads to certain outcomes in analysis. Given that the gap that the screen creates can only be 'closed over' under these assumptions, how might more be revealed as to the ontology of the screen? The key lies not in trying to close over a pre-existing gap, but in finding how that gap was generated and changing the assumptions of the argument to avoid generating it in the first place. This means re-thinking the starting point of the analysis.

The screen establishes a gap, and it does so because this is the relation that produces it. The screen is a barrier, it is a frame, it is a force and a tool. But it is also none of these things, as each is preceded by a set of relations that generates this understanding. The next section will concentrate on this indeterminacy by inverting the primacy of relata and relation. It will focus on the relations of materiality and agency in the provocation of the 'screen' in perception. In other words, it will assume that the world is composed of relations, and that these relations generate relata.

100. Martine, *Indeterminacy and Intelligibility*, 4.

CHAPTER TWO

A STRETCHED PLANE

Relations and the ontology of the screen

Moubie and Gaze Returner

Moubie and *Gaze Returner* sit between me and my space, always in excess of the screen.[1] In a way, they are screens, but more accurately they *have* screens, and they use these screens against me. They explore and expose material agency, influencing the ways that 'subject' and 'object' are brought about. Each uses the screen as a site of display for its own point of view, but they have different forms and behaviours, making them more or less active or passive, more or less agential, more or less friendly. They assert themselves over me and my spatiality differently. They're not screens as I know them, but they're not machines or animals either, they're a little hard to place and hard to know how to respond to.

Fig 16. *Gaze Returner.*

Gaze Returner looks so passive, a black screen framed in a black box. As I move closer, though, this passivity changes. The black screen becomes redder and redder, until it glares brightly and suddenly shuts off. I wonder for a moment what he's doing until I see myself, my own image, on his face.

Gaze Returner's circuit is composed of a camera, an ultrasonic distance sensor and a small LCD. He reads the distance sensor and converts the signal to a colour value, which he then displays, as if in warning. Once a threshold is passed, he returns my gaze by photographing and displaying my face as I look at him, the face I reserve for objects, now looking at me.

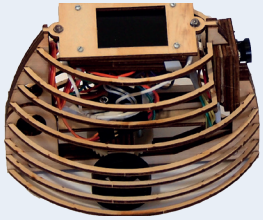

Fig 17. *Moubie.*

Moubie is much friendlier. He's moving around on the floor, occasionally bumping in to things. He always tells me which direction he's going to go, so I can get out of his way if I need to. He doesn't show me my face, but he shows me what he sees. Every few seconds he'll show me his point of view. I start to follow him, looking down at his back so I can see through him and out to his space.

Moubie's form is encased in a wooden skeleton. He has a set of wheels driven by a servo motor, a camera, a small LCD and a set of LEDs. He determines a direction of movement, indicates this direction with the LEDs and moves forward a fixed distance. He then photographs his space and displays this image on the LCD mounted on his back for me to see.

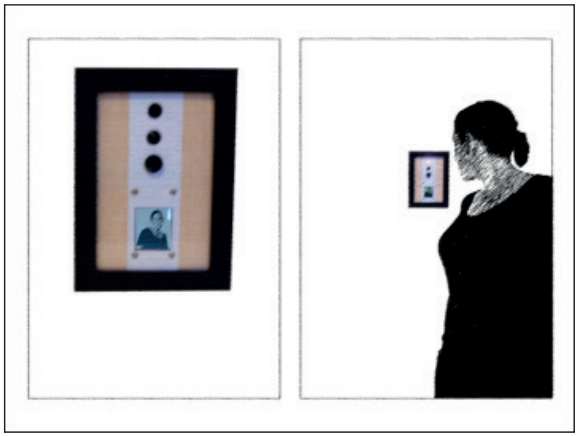

Fig 18. *Returning Your Gaze*. [Video, 00:17].

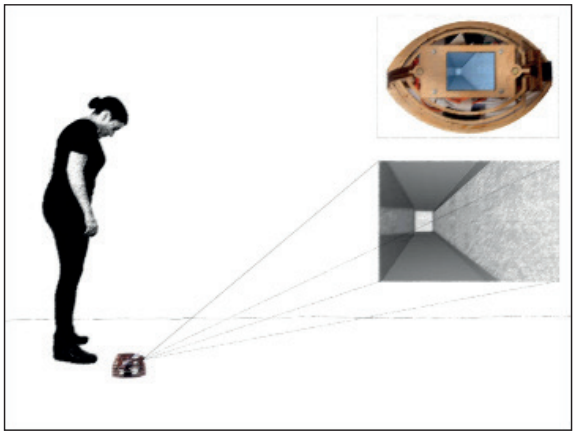

Fig 19. *Hijacked Perception*. [Video, 01:00].

1. See appendices E and F for circuit diagrams and code.

STRUCTURE OF A RELATION-BASED ANALYSIS

The previous chapter focused on the relata of screen interactions and revealed the screen as something which is negated. The screen produced a gap, a gap which is put to use in screen-person interactions. The screen becomes 'for' introducing, dividing or contextualising space – uses that are dependent on the way it creates a spatial gap. But this gap was something that happened to the screen as well as from it, in that the materiality of the screen-as-relatum had to be negated in order to properly create the gap. There was also something in excess of this negation, something which had to be negated. Alterity was introduced as a mechanism by which to provoke this excess. The *Behaviour Boxes* expressed their role in the relations they established, as part-roles of the screen. As they did so, they started to establish themselves as something more than screen—objects. They did not appear as screens as they did not create a spatial gap. Instead, their responses were social and expressive. A tension was thus discovered between the use of the screen in its production of a spatial gap and a set of ancillary behaviours which drew attention to the screen itself as the material anchor of this gap. Rather than strengthening the role of the screen-as-relatum by purposefully expressing the screen's role in the interaction, these ancillary behaviours interrupted the way the object was revealed as 'screen'.

This tension indicates that a different mode of analysis is needed to explore the screen. Although the relata-based approach could explain what the screen represents, it could not explain the gap generated between what the screen is and what it does. This chapter will address the tension between the screen's use and its object by exploring the screen from the perspective of relations. It will establish materiality and agency as productive forces and key mechanisms in the revealing of the screen, discussing the screen-bearing object as provoking two contexts: the 'for', as the use-context that underlies the revealing of the screen; and the 'not-for' or 'for-itself', which interrupts this use-context and reveals the excess of the screen. This chapter looks at the ways in which materiality and agency as processes can support or contest screening.

A relation-based approach has a different structure to a relata-based approach. This section will begin by qualifying the position of the relation in this analysis, particularly as it involves the context of use. It will then discuss this positioning against the screen's disappearance, and define the relations of materiality and agency, rather than use, as responsible for defining the differences between screen relata. The section will conclude by defining the figure of the analysis.

In this analysis, the primacy of the relata and relations in analysis will be inverted. In the relata-based analysis of the previous chapter, the relata were held as *a priori* entities that enter into a relation. In this way, the relata, by means of their properties, determine the relation. A relation-based analysis will, instead, focus on the qualities and peculiarities of the relations – it will look between the relata rather than at them. These relations, however, will no longer be considered reflexively as the product of discrete relata, but instead as generative of the relata themselves.[2] This constitutes an inversion of priority – the last chapter looked at relata as producing relations, this chapter will look at relations as producing the relata. The relation here comes before the screen emerges in perception, so that the screen-as-relata is a perceptual 'reaction' to the relations discovered.

Chapter one found that the relation of use had a large part to play in how the properties of relata are defined, but that the screen's material lay in conflict with its use. The use relation, then, is not the most appropriate for finding a relational ontology of the screen. This tension can be explored further using the concept of the ready-to-hand.

Heidegger gives a definition of things according to their relation of use and the context in which they arise, as *zuhandenheit* or readiness-to-hand. In discussing equipmentality in *Being and Time*, Heidegger notes that equipment is always in relation to other equipment. Things do not show up on their own, rather they are discovered according to an "arrangement" of equipment; a context of other things to which they refer. A room, states Heidegger, is encountered as "equipment for residing," a hammer as equipment for hammering. The room itself, or the hammer itself, is encountered within this relational context, so it is discovered in accordance with the uses and contexts to which it refers: "it is in this that any 'individual' item of equipment shows itself. Before it does so, a totality of equipment has already been discovered."[3]

Heidegger indicates here that the relation between things occurs *a priori* to the things themselves. However there is a difference between the ready-to-hand and the type of relational approach that will be demonstrated in this analysis. Readiness-to-hand belongs specifically to the context of equipment, and more specifically to the context of use.

2. In considering relations as prior to relata, this chapter focuses on indeterminancy – it tries to find meaning before the determination of relata. Brian John Martine outlines that such an approach conflicts with the "determinately biased models" of common understanding, but that this does not mean that indeterminacy is unintelligible. He suggests that better understandings can be gained from "making a place for a certain indeterminacy." Brian John Martine, *Indeterminacy and Intelligibility* (Albany: State University of New York Press, 1992), xiii-xiv.

3. Martin Heidegger, *Being and Time,* trans. John Macquarie and Edward Robinson (New York: Harper Collins , 1962), 98. Heidegger writes: "this kind of Being which equipment possesses – in which it manifests itself in its own right – we call 'readiness-to-hand'. Only because equipment has this 'Being-in-itself' and does not merely occur, is it manipulable in the broadest sense and at our disposal… When we deal with them [things] by using them and manipulating them, this activity is not a blind one; it has its own kind of sight, by which our manipulation is guided and from which it acquires its specific Thingly character."

The hammering does not simply have knowledge about the hammer's character as equipment, but it has appropriated this equipment in a way which could not possibly be more suitable.

Martin Heidegger[A]

What is a screen for, anyway?

I don't use it like I use other things. If I pick it up, it becomes something else – a phone, a computer. If I look at it, it becomes something else – an image, a filter. If I dissect it, it becomes a myriad of things – a wall and a motor and a light source and a strip of film or a series of binary notations compressed into an array. I can run the motor, I can contemplate the wall, I can touch the phone or type on the computer or look at the image; but what is the screen for?

Equipment has a type of being related specifically to its use and responsible for its use. It is because a thing can be used that it is called it a thing. In other words, the thing is a material expression of the use context in which it arises; it is something 'for' something. Using things thus helps us discover the world of our involvement, and, along with it, ourselves as involved and equipment *per se*. Heidegger describes readiness-to-hand as a withdrawal of the thing from perception in order to be put to use.

The 'disappearance' of the screen was discussed in similar terms to 'withdrawal' in the last chapter, as a negation. In this sense, readiness-to-hand could be considered as the relation that allows the screen to be contextually placed. The 'withdrawal' of the ready-to-hand could explain the negation of the screen relatum. However, it was not clear from chapter one that this is how the screen withdraws. The various impacts and actions identified in the last chapter mean that what the screen is *for* is not reflected in its material. It is not clear that the screen withdraws into its use in the same way as a tool. The screen in its context seems to show a different kind of relation to use than the ready-to-hand tool.

To explain this difference more thoroughly, I refer back to the tool relation. The withdrawal of the tool into its relation of use – or, perhaps more consistently with the structure of a relation-based analysis, its failure to surface as a thing separate from the use to which it is put – is part of human directedness toward the world.[5] The tool is seen *through* as intent focuses perception on the task at hand – the product of the relation. The negation of the screen is of a different order – it is not only looked through (as the hammer is toward the hammering of a nail), but looked at (as the smartphone is while held in hand). The more the tool is looked at rather than used, the less we know of it.[6] At this point the tool becomes accessible as a relatum – a thing with properties that determine how it is useful. But this is not so for the screen. Looking *at* the screen is part of its use, and the more the screen is looked at, the more it is negated: the perceptual terminus remains in the object and the space at the same time. Hammering

4. Heidegger, *Being and Time*, 98.
5. Heidegger outlines the nature of equipment as "something in-order-to…" so that a "totality of equipment is constituted in various ways of the 'in-order-to', such as serviceability, conduciveness, usability, manipulability." The use context thus constitutes the thing itself in perception: "In dealings such as this, where something is put to use, our concern subordinates itself to the 'in-order-to' which is constitutive for the equipment we are employing at the time." Heidegger, *Being and Time*, 97-8.
6. "No matter how sharply we just *look*… at the 'outward appearance'… of Things in whatever form this takes, we cannot discover anything ready-to-hand." Heidegger, *Being and Time*, 98.

> In order to be present, any being must persist in time. This means the form of the thing – that which makes it actual – must be identifiable as the same throughout all possible repetitions. But this iterability implies that any presence is in its very constitution always riven by a radical alterity that makes it impossible even as it makes it possible.
>
> *Pheng Cheah*[7]

Relational design

Relata arise from an encounter as the pulling out of a 'thing' from a relational field, then referring it back to that field – something that happens momentarily, continuously and iteratively. This is a kind of reversal of the construction of the object, a bottom-up move where relations spawn things.

Meaning is carried by these things, and the shared terms that describe them: 'virtual', 'real', 'subject' and 'object'. Meaning persists in the sedimentation of the field of relations, the things begin to stand in for the field out of which they arose. This is a top-down move where relations happen between pre-existent things.

If the relata are pulled out, what is left behind? How are things when they are just their potential?

Design has a strange task in this *a-posteriori-a-priori* perceptual process – the thing I am interacting with arises out of the interaction itself, but has to be brought back in to the beginning of that interaction to form

exists between the body, hammer, and nail. Screening exists within the screen, as the screen-as-relatum and space-as-relatum are held by the same object anchor. In other words, the hammer never becomes the nail; it becomes a part of my intentionality toward the world. But a television can become a landscape, or a building, or another person through which I move and to which I respond. In other words, the screen always shows what it is not – what it shows is outside of its own context.

The implications of considering the screen as ready-to-hand are that it can be used, within the context of equipment, towards a human aim. But when the screen is 'used', it is conflated with the space it produces, which lies outside of its equipmental context. The human is displaced from this production of space. The screen does not reveal the world of concern for a person, but for itself.

What relations, then, reveal the screen? Looking at the character of the relations *entered into* by relata cannot reveal the character of the screen in a relation-based analysis. The use relation too easily slips into a reflexive relation in which *I* use *something*. Although the use relation can potentially occur in both directions (from the subject to the object, and from the object to the subject), it could only do so by virtue of the pre-existence of points of the relata. An *a priori* relation needs to be capable of generating the very directionality that is defined by the relata. The qualities of the generative relation will occur in all directions at once – not as a multi-directionality of things caught in a network and acting toward each other, but in the sense that directionality surfaces from within relations themselves.

7. Pheng Cheah, "Non-dialectical Materialism" in *New Materialisms: Ontology, Agency and Politics* ed. Dianna Coole and Samantha Frost (London: Duke University Press, 2010), 74.

its basis in the first place; just as I do, as the reflexive subject. But if I am designing a thing for someone else to interact with, I am trying to fix this process for them. I am trying to call forth a thing for them, and am giving the thing itself the task of communicating this intent.

Design is, conventionally, a relata-based discipline. I design for the form or function of a thing, and so I assume a predetermined subject, object and space. I have already overtaken the point at which the thing is effectual. How can I design for generative relations? Is there a role of design in finding the excess of the thing?

If the relation pre-exists and constitutes the relata, then the relata are revealed by the relation together. The relations that are responsible for the screen appearing as such in perception, then, need to be able to generate the subject and object, real and virtual concurrently. The relation is, in this sense, a difference out of which the two poles of the relata are generated.

Finding what creates this distance involves considering how the relata of the previous chapter were different from one another, then looking for how this distance is created. Two differences repeatedly arose in descriptions of the oppositions of relata – agency and materiality. This section will carry these relations forward and understand them as generative. That is, rather than approaching agency and materiality as properties of relata, they will be considered as forces which produce a difference, thereby distancing and defining relata.

The first step in this process is to find how the difference between the relata is defined. The previous chapter found that the screen-as-relatum was doubled, then doubled again. This doubling first occurred into a screen that opposed a subject and a screen that opposed a space. Within this first distinction, a second doubling occurred – into the screen effective and affected, and into the screen subsumed into the virtual and the screen stubbornly real. Rather than being an action unique to the screen and its ontology, this doubling was connected to the method of analysis, which the screen made uniquely apparent. Distance was introduced between relata by virtue of finding these relata across a difference. When considered in terms of the screen, this distance had a certain character. In both of the dichotomies discussed, issues of materiality and agency defined the difference between relata. But this distance was part of the assumption of the analysis; it was taken for granted.

Rather than approaching distance as an *a priori* entity, a process of *distancing* can be found which corresponds to the creation of a difference within relations. The last chapter discussed Baudrillard's idea that simulation threatens the relata-based system of meaning – of defining a relata according to its dichotomous other – by collapsing the real into the virtual. Baudrillard seems to approach this as a negation of pre-existent difference, a difference that itself accounts for meaning.[8]

8. Baudrillard remarks that the TV must be conceived "as an effect in which the opposing poles of determination vanish, according to a nuclear contraction, retraction, of the old polar schema that always maintained a minimal distance between cause and effect, between subject and object: precisely the distance of meaning, the gap, the difference… irreducible under pain of reabsorption into an aleatory and indeterminate process whose discourse can no longer account for it." Jean Baudrillard, *Simulacra and Simulation*, trans. Sheila Faria Glaser (Ann Arbor: University of Michigan Press, 1994), 31.

Here, of course, the underlying assumption was that they had some fundamental characteristics that could be described independently of their relations to one another.

Brian John Martine[10]

Similarity and difference

Relata are defined by what they are not. But I can never know this thing that things are not. All sorts of things are not a screen – coffee cups, water, hammers, Pluto. But what is a non-screen?

Determinacy makes the indeterminate its own abstract entity. I have no access to this entity. The otherness of the screen, all the things it is *not* (and so, conversely, what it *is*) is not accessible in its own right. I can meet a sort-of screen, something that looks like a screen or acts like a screen or has a screen along with other things. These aren't really screens, but they have screen-like tendencies. They are close to the screen, they are related. The screen is defined by what it is not: the non-screen. But everything that others the screen is related to it.

I can never meet a non-screen.

However, if the directionality of this statement is reversed, if the pre-existence of the "distance of meaning" is questioned, the television could instead be considered as refusing to reveal this distance simply. The distance between relata in screenic ontology is revealed in many, often contradictory, ways so that dichotomies cannot be simply resolved. Baudrillard sees this as an abolition of the relation because it calls causality into question.[9] It could instead be approached as an expression of the relation's power – not the reflexive relation of causality, but the generative relations out of which the relata are formed. *Distancing*, as a relational process, could be seen as so effective in this scenario that *distance* is revealed simultaneously in contradictory directions.

In this sense, the relational context presents itself as an effective device by which to examine screen ontology. To do so, materiality and agency – the terms by which the distance between the relata of subject and object, virtual and real are defined – will need to be re-defined as processes, of means of creating difference and thereby creating relata.

9. Baudrillard writes that "indeterminacy is ... the abolition, pure and simple, of the *relation*." Baudrillard's relation is a reflexive relation. It relies firstly on determination as the origin of cause and effect, and thereby meaning. With the television, however, "there is no longer the transversal of an effect, of an energy, of a determination." Simulation begins in this movement as value is no longer held in the relation between *things;* and without things as origins of cause and effect, the world is unintelligible . Baudrillard, ***S****imulation*, 31.
10. Martine, *Indeterminacy and Intelligibility*, 1.

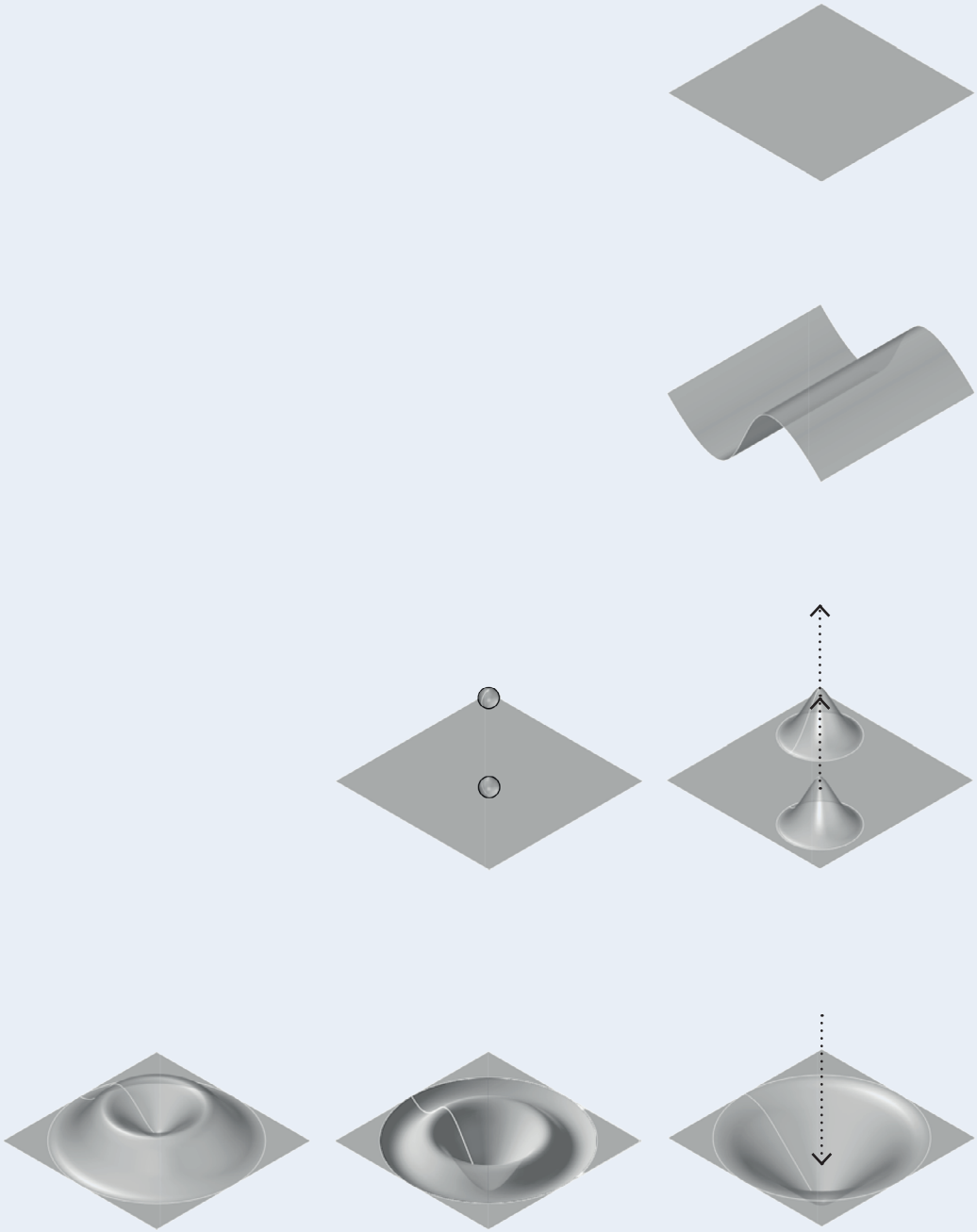

Fig 20. *A Stretched Plane.*

Viewing relations in this way presents a different kind of figure to the axis. Without the points of definition of the relata, relations begin as a plane or a surface. The qualities of these relations are not defined or quantified as they are indeterminate, existing only as relational possibilities. Generative relations resist determinability because they cannot easily be assigned to a particular object or form. They belong to a processual rather than formal code of understanding. In this sense, the plane is homogenous. There is no determinate thing presented, because there is no difference by which that thing might be defined. As Martine comments, "no determinate position of any kind can be marked out without an intelligible other."[11]

If the figure of relations is left here, it is impossible to say anything meaningful about the screen's ontology. It is impossible to say, in fact, that there is a screen, or indeed, anything at all.[12] However that does not mean that this relational surface is inaccessible or unintelligible. The relational surface is not be phenomenally knowable; it is unable to be seen or touched. Moreover, the screen relatum cannot give access to the relations that produce it. This surface does remain accessible, though, through difference. Once a disturbance is made in the plane, qualities can be identified through the differences between them. Such a disturbance can reveal the nature of the relational surface – that is, it can show how difference arises as well as the difference *per se*.

This disturbance needs to be performed in a particular way. Drawing up of the surface at certain points would only reveal the same relata – points within the surface would be selected for consideration, and the relational surface would fall back into the background. The intentional nature of an action of drawing out would interfere with its aims.[13] To keep hold of the relational surface, it should instead be pushed at points of tension. Such a move would stretch the surface, allowing it to react and throw relata back in response to provocation. In this way, "the indeterminate comes to the fore as the ground out of which the determinate systemic account has arisen in the first place," and the nature of the relations can be better understood.[14]

The figure of the relational surface has a temporality that was absent from the figure of the relata. It involves a moment of movement and reaction. The intent of this chapter is to explore points of tension in the relational surface, and to push a reaction; to provoke new sets of relata from the relational plane. As these new relata are revealed,

11. Martine, *Indeterminacy and Intelligibility*, 22.
12. Relata only arise after determination. Determinations are made by referring one thing to its 'other'. This process is reliant on difference. If determinations are made across differences in the relational plane, a still and homogenous plane cannot produce relata.
13. Drawing out relata would mean "re-separating – for reflective inspection – a logical element from a larger framework to which it nonetheless continues to be bound." In making this selection, the larger framework cannot be revealed, and it becomes "all too easy to treat a term so abstracted as if it had a genuinely independent character." Martine, *Indeterminacy and Intelligibility*, 49.
14. Martine, *Indeterminacy and Intelligibility*, 16.

> The task before us is not simply to make things or to resolve relations into things, more and more minutely framed and microscopically understood; rather, it may be to liberate matter from the constraint, the practicality, the utility of the thing, to orient technology not so much to knowing and mediating as to experience and the rich indeterminacy of duration.
>
> *Elizabeth Grosz*[15]

Designing to stretch

What is designed in an object? Is it that object's purpose, its use, and a form that allows this to take place? Is it the screen-bearing object that is designed, that which allows the 'screen' to be revealed? A designer makes a form makes an effect. The thing becomes a vehicle for the designer's intended experience. But how can this show us a relational field?

There are four causes, four ways in which things are created – the material of the thing, the form of the thing, the end to which a thing is put, and its means of production. Together these 'cause' the thing.[16] If the thing is made in these causes, then what does the designer do? Do they set themselves outside this process, controlling it externally? To access the thing as it is not, rather than the thing as it is accepted to be, asks for a displacement of design intent. The process can't be fixed, it can't be driven purely from outside.

Gaze Returner and *Moubie* are an interrogation. They strike at a particular point in the screen's relational field while having very little to do with it, stretching it a little so that it might produce something else, some alternative relata that is almost a screen, but not quite. These alternative relata might not be 'screens', nevertheless they emerge from the field of possibilities that defines the screen. In trying to describe the relation more fully, they forbid themselves from emerging as the screen. They show a non-identity with the screen.

Gaze Returner and *Moubie* use three strategies to design from the inside: an anti-function, an anti-aesthetic and a limited intent.

so too might something be revealed of the relational plane itself. Discursively, this will be done by exploring definitions of agency and materiality as processes and using these to discuss the screen as something that arises in perception. That is, the relata of the screen will be positioned as a perceptual reaction to a point of tensions in material and agential processes. Two created things, *Gaze Returner* and *Moubie*, will work within this structure as moments of deformation in the ontology of the screen.

15. Elizabeth Grosz, *Architecture from the Outside*, 182-3.
16. In *The Question Concerning Technology*, Heidegger outlines *poesis*: "there are four accepted causes – the materiality out of which a thing is made (causa materialis); the form of the thing (causa formalis); the end to which a thing is made/ its use (causa finalis); and the way it is brought about/means of production (causa efficiens)." Martin Heidegger, *The Question Concerning Technology and Other Essays*, Trans. William Lovitt, (New York: Garland Publishing, 1977), 6. The four causes responsible for the appearance of the thing as itself and are united in poesis. The role of the craftsman in this is as one who "reveals what is to be brought forth." Ibid, 6.

Anti-function steers away from use and towards function's excess. Otherness, alterity, cuteness and incidental engagement are created, and these contest the "for" of screening. These ancillary behaviours of the object interrupt the way that the screen is revealed by showing different relations – between screen and body, and screen and space. *Gaze Returner* is driven by sight lines – its own and that of the interactant. Functionality is considered in terms of these new relations only, not in terms of achieving an intentful aim.

However, a lack of functionality doesn't imply a formal emphasis. Aesthetics are not so far from a function in themselves. An anti-aesthetic approach is also taken, so that the form of the object is steered by its own requirements. The orientation of components and the materiality of processes drove *Moubie* to look as he does, his minimal skeleton a support more than an enclosure.

I am trying to limit the impact of my design intent. I certainly have reasons behind making these objects. They are *intended* in the sense that they need to do certain things. But in keeping them as simple and unformed as possible, I am hoping they can't be 'read', that they can't fall easily into the assumptions of a known relatum.[17] I am hoping that, in not intending them *to be taken* in a certain way, intending them for human use or human desire, they will be able to express themselves. I hope to "let the jug's void be its own void."[18] If a thing *is* as it is made, an indeterminate design process should produce an indeterminate thing. For this reason, my intent is to negotiate, so that the developing object can have its own role in the design process.

In this way, the screen thing might remain open enough to suggest a host of new relations, and the limits of 'screen' might emerge differently. The non-screen, the field of relations that throws the screen out as relatum, might be glimpsed in something that is a screen, but is also not a screen. But it is a paradox – designing out the designer, willing a lack of intent, creating for another's self-creation.

Is indeterminate design possible?

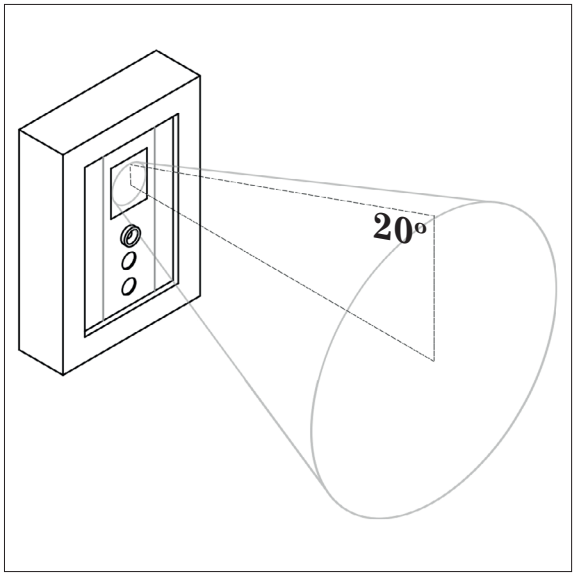

Fig 21. *Restrictive Behaviours.*

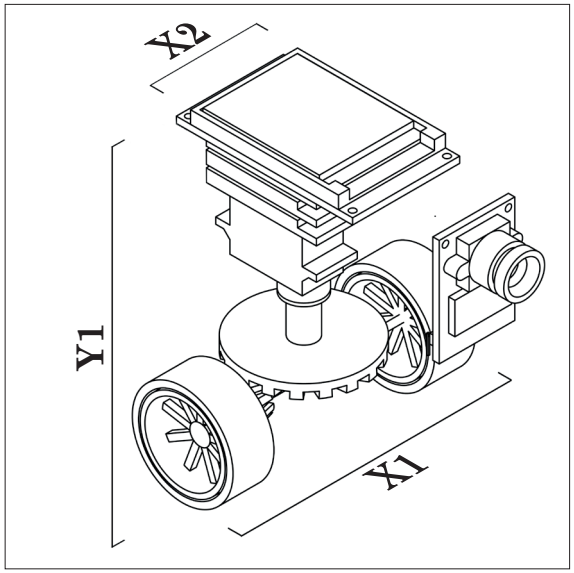

Fig 22. *Self Dimensioning.*

17. This approach is intended to keep open the determination that comes quickly in knowing an object 'type'. Grosz holds that determination is necessary to provide for action: "The possibility of action requires that objects and their relations remain as simplified as possible, as coagulated, unified and massive as they can be so that their contour and outlines, their surfaces, most readily promote indeterminate action" Elizabeth Grosz, *Architecture from the Outside,* 172. By keeping objects simple, the scope of use is broadened, and can be explored rather than assumed.
18. Martin Heidegger, "The Thing" in Poetry, Language and Thought, trans. Albert Hofstadter (New York: Harper and Row, 1971, 169.

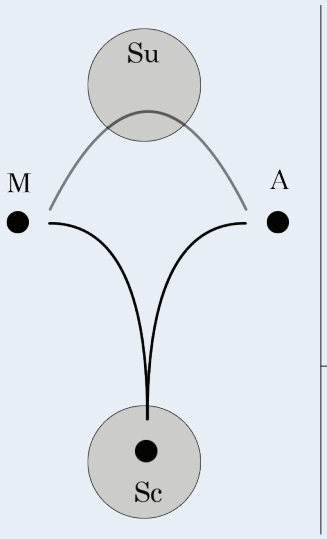

Fig 23. *Difference and Order.*

REVEALING THE SCREEN

Approaching materiality and agency as generative forces rather than the properties of discrete relata requires a change of definition. These entities can no longer be seen as static, determinate things, fixed to the object and the subject respectively; they must be approached as processes. I will now explore materiality and agency as processes to come to an understanding of how material and agency (or to use more processual terms, materialisation and agentialisation) might generate the ontological condition of the screen. This exploration will begin by reframing materiality as a process that generates 'inert' material, and the impact of this conception of materiality on screen ontology. It will then perform a similar task for agency, reframing agency as a process that is able to generate an agential material rather than discrete subjects. These relations will then be examined in terms of the relata they generate – that is, how the screen can be determined from agency and materiality as processes. The exploration will end with a discussion of what is left in excess in this determination, and the role of the use-less in provoking screenic relations.

Materiality, materialisation and the screen

Chapter one found that the subject—object and virtual—real dichotomies were both reliant, in part, on a difference in materiality. The screen acted upon materiality and was acted upon as material. I will try to show a different sort of materiality here, one that generates the screen rather than belonging to it as action or property. This section will begin by looking at the distance introduced by materiality. It will then use ideas from Diana Coole and Giuliana Bruno to discuss materialisation as it relates to the screen, and introduce Maurice Merleau-Ponty's conception of embodiment to relate this process back to the generation of the subject-object dichotomy. The section concludes with a discussion of the impact of this conception of screenic materiality on agency.

Material distance

The materiality of things is difficult to attend to. As Coole and Frost observe, "there is an apparent paradox in thinking about matter: as soon as we do so, we seem to distance ourselves from it, and within that space that opens up, a host of immaterial things seem to emerge."[19] These immaterial things, amongst which Coole and Frost list subjectivity and agency, are then taken as "fundamentally different" from matter because they arose from a distance with it. This spacing was shown in the relata-based analysis: as the material screen was considered in terms of its effects, it began to be understood instead according to nonmaterial properties – social forces, representations and

19. Diana Coole and Samantha Frost, "Introducing the new materialisms" in *New Materialisms: Ontology, Agency and Politics* ed. Dianna Coole and Samantha Frost (London: Duke University Press, 2010), 1-2.

so on. Moreover, because of this spacing, the material screen could only be seen as inert and static. The distance that opens around the screen is equal to the distance between active intent and passive material.

This distance, however, did not quite work in providing an understanding of the screen. The relata-based analysis found that the screen impacted matter by 'de-realisation', a taking-away of matter from the subject's use. Yet this dematerialisation happened to the screen at the same time as the screen performed it. A material difference that happens both to and from the screen suggests that the screen has a role to play in *generating* materiality at the same time as being *generated by* materiality. The material difference that opens around the screen is bidirectional, it happens to and from the screen at the same time. This suggests that the materiality of the screen may be more complex than the relatum-based definition of matter implies.

To explore material according to the assumptions of a relation-based analysis, the familiar world of inert things, ready to be put to use, must somehow arise in perception. There must be an underlying relation that reveals inert matter, a relation that itself would be both hidden and generative. Diana Coole describes materiality in such processual terms. I will use her essay "The Inertia of Matter and the Generativity of Flesh" here to redefine the materiality of the relata-based chapter as a generative relation.

Generative materiality

Coole notes that the generation of this familiar material world is not often accessible, as "we rarely pause to consider the contingent processes through which our familiar, visible world comes into being."[20] Coole addresses this generative relation, which she refers to as the "creative contingencies of perception" firstly by introducing a distinction between *natura naturans* and *natura naturata*. This distinction arises in Spinoza's philosophy as distinguishing between process and product, between nature naturing and nature natured.[21] Although the terms have been used as a differentiation between the organic (self-generating) and inorganic (inert) stuff of nature, Coole develops these active and passive senses of nature into a definition of materiality as an active process. The distinction between *naturans* and *naturata* effectively questions the assumption that matter is inert, indicating that the process of matter's production is an active materiality.

Coole attempts to reunite the process and product of matter, and focuses particularly on Merleau-Ponty's work in grounding the

20. Diana Coole, "The Inertia of Matter and the Generativity of Flesh" in *New Materialisms: Ontology, Agency and Politics* ed. Dianna Coole and Samantha Frost (London: Duke University Press, 2010), 104.

21. Merleau-Ponty traces the distinction between *natura naturans* and *natura naturata* to Averroes, an Andalsuian-Arab philosopher. Coole, "The Inertia of Matter," 97. Spinoza's discussion of the terms as substance and cause (*naturans*) and effect and mode (*naturata*) are said by Deleuze to be immanently connected: "the cause remains in itself in order to produce… the effect or product remains in the cause." Gilles Deleuze. *Spinoza: Practical Philosophy*, trans. Robert Hurley (San Franciso: City Lights Books, 1988), 92-3.

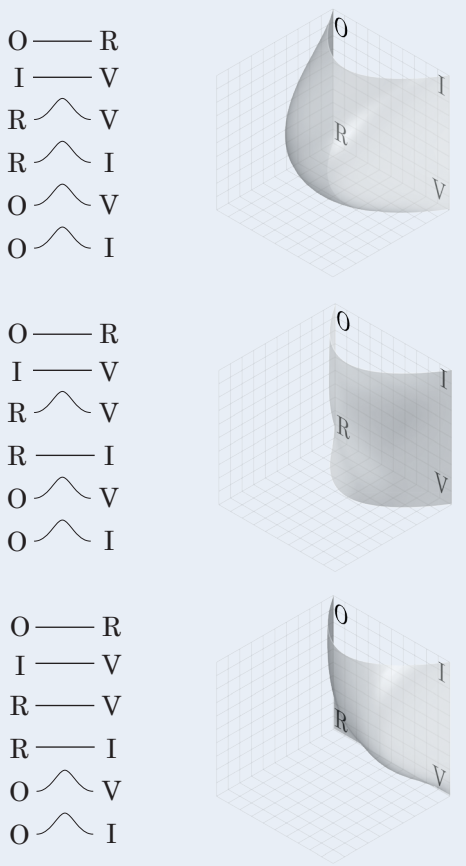

Fig 23. *Difference and Order 2.*

generative force of *naturans* in a material way. Rather than introduce a generative materiality as a mystical and unknowable force aligned with theology; Merleau-Ponty grounded materiality within immanent, everyday life. A focus on embodied perception allowed Merleau-Ponty to propose a subject that is enmeshed in materiality, and a material world that generates this subjectivity.

I will return shortly to consider the role of Merleau-Ponty's embodied perception in the material relation more thoroughly. Firstly, though, I would like to note that the materiality described by Coole shows a significant change in the direction of the argument. In chapter one, the object and subject produced a material relation. Here, the material relation arises across a difference in materiality, and generates the subject and object according to this difference. Materiality generates the relata of the 'active' subject and the 'inert' material with which they interact. Thinking of materiality as a process that generates relata poses problems for understanding the screen. The screen was found as relata only in its perceptual negation – it lacked an 'inert' material. For the screen to be generated by a process of materiality, materiality as a process would have to be capable of generating this lack of material as well as the static material of objects.

Inert screens and ongoing screening

One way of addressing this conflict of materiality is to refer to the active form of the screen – the screen in screening. The verb has implications of sorting and ordering, of allowing certain things through and others not. Last chapter, this aspect was defined in terms of the screening of sensorial information. This approach relied on a conception of sensory perception as the reception of relata – discrete packets of sensorial information that pass through a filter. Such a definition is not appropriate in a relation-based analysis as it frames perception as passive.

Giuliana Bruno, on the other hand, suggests that screening has a generative form, in that it produces a new materiality from something else. Although she presents this as a reflexive process, a "mediation between subjects and with objects," there is a sense in which Bruno's screening materiality is generative, in that it "involves a refashioning of our sense of space and contact with the environment, as well as a rethreading of our experience of temporality, interiority and subjectivity."[22] Bruno's screen 'screens' the senses by refashioning spatial experience. It shapes materiality in a way that suggests it is itself inside material processes, that it has a role to play in bringing about 'inert' materials.

Understanding the screen as generating materiality requires a particular view of the 'inert' material as relatum. Bruno's screen is a composite of the 'real' material of the surface and the 'virtual' materiality of the image.

22. Giuliana Bruno, *Surface: Matters of Aesthetics, Materiality and Media* (Chicago: University of Chicago Press, 2014), 94; 8.

'Material' is thus defined as a condition rather than a property. It is not the texture or composition of the surface that is regarded as material, but the surface as "activating material relations."[23] This reveals a potential mechanism for the screen's negation – the screen reveals a reorientation of materiality, and brings into focus materiality as a virtual process.

The material of the screen is not 'virtual' in the sense that it 'belongs' to the immaterial image as the relata-based analysis found; rather it is virtual in the sense that the process of materialisation exists as a set of relational possibilities.[24] If materiality is a relational process that brings about material 'things', then the relation ends in an act of determination – in the formation of relata. Before this determination, materiality is indeterminate, it is the *possibility* of things rather than the things themselves. The screen participates in generating materiality at this point, before the determination of relata. It is only in performing the determination that these possibilities become actualised.[25] The generative relation of materiality is, in this sense, a virtual condition. This may be the sense in which Bruno declares that "in the digital age, materiality can be reactivated, because it was always a virtual condition."[26] Materiality in this generative sense hides behind the clearly defined relata that it generates, as these are what remain accessible in perception. But the screen resists determination as a relatum, and so draws attention to the process of materialisation by refusing to become static material. The 'inert' material of the screen can only be seen from outside the generative material relation in which it participates.

The screen participates in an ongoing materialisation at the same time as it lies outside of this process. In as far as the screen generates materiality and refuses to become material, screening becomes an act of materialisation in itself. This understanding leads towards a conception of the screen that defines it according to its mode of production – the spaces it produces rather than how it itself comes about in perception. That is, we lose sight of the experience of the screen again. How can the screen be generated from within materiality even as it generates it?

Material reciprocity, person and screen

Questions about the role of the screen in materiality prompt an exploration of reciprocity within material relations. So far,

23. Bruno, *Surface*, 8.
24. The term 'virtual' will be used in a number of ways in this chapter – to refer to the relatum of the virtual, to refer to possibilities for action, and to refer to things as we perceive them. In this case, the term 'virtual' refers to an underlying possibility that has not (yet) been enacted. The term is thus used here in a similar sense to Manuel DeLanda, as a set of "dispositions, tendencies and capacities that are virtual (real but not actual) when not being currently manifested or exercised." Manuel DeLanda, *Assemblage Theory* (Edinburgh, Edinburgh University Press, 2016), 108.
25. Determination involves the drawing out of relata as a set of properties. In the action of "making-determinate," boundaries are established around things and they become 'actual entities. Martine, *Indeterminacy and Intelligibility*, 32-37.
26. Bruno, *Surface*, 8.

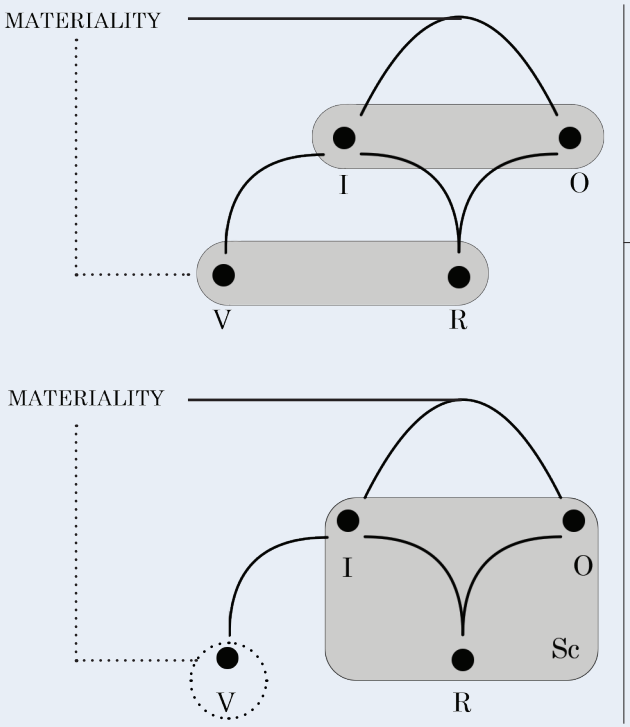

Fig 24. *Material Differences.*

this chapter has reframed materiality as a process, and found that the screen relatum surfaces from an ongoing material relation as an 'inert' object, but it also participates in the ongoing material relation. Referring back to the assumptions of the analysis, materiality as a process needs to be capable of generating the subject relatum from these relations at the same time as the object relatum. The dual positioning of the screen as both inside and outside materiality introduces a paradox for the subject: materiality brings forth the object and the subject as relata at once as an active material relation. But the screen also materialises spaces and materials as part of what it produces. The subject must be found alongside these materials as well. Screenic materiality asks for a perceptual split, so that the 'subject' as relatum can be found alongside the static object of the screen at the same time as it is found alongside the material produced by the screen.

Just as the material screen is found outside of materialisation as a static object and inside as an active process; so the materiality of the subject, the embodied person, needs to be found as the static, external subject and from within an active process of materialisation. To establish a mechanism for this dual subjectivity, I will return now to Merleau-Ponty's ideas about embodied perception, and its role in materially situating people. Rather than consider the person who finds themselves alongside these screens as an immaterial subjectivity based on agency or intent, I will consider this person in terms of embodiment.

Embodiment inside and outside materiality

Merleau-Ponty sees the body as the locus of material relations. He shows the body as something generative as well as something found reflexively, saying that a knowledge of the body as one's own materiality is different from the experience of embodiment itself.[27] The body that spatialises and perceives within material relations is not the body that is known or found from these relations. The first is a body that "is the unperceived term at the center of the world," the second a body of which a person is conscious "through the world." The body within material relations, then, is unknowable. The body *per se* or body—as—relatum are found reflexively as an "object of the world"; but the body within material relations is a "means of communication" with the world.[28] If this first body is within the relation of materiality, it is cast out of it as the second, stable and reflexive body. In this sense, the embodied subject is found along with the material, as a casting out of the material relation. Merleau-Ponty makes a point of holding these two conceptions of the body apart.

When considering the screen in terms of the body inside and the body outside of materiality,

27. Merleau-Ponty writes: "To say that it is still me who conceives of myself as situated in a body and as furnished with five senses is clearly only a verbal solution; since I am reflecting, I cannot recognize myself in this embodied I, since embodiment then remains in principle an illusion and the possibility of this illusion remains incomprehensible." Maurice Merleau-Ponty, *Phenomenology of Perception*, trans. Donald A Landes (London: Routledge, 2012), 221.
28. Merleau-Ponty, *Phenomenology of Perception*, 84; 95.

it becomes apparent that the reflexive body found facing the screen may be a different sort of body to the one that was directed toward the screen in the first place. Holding these two bodies apart can provoke an uncomfortable experience.

Lynda Benglis' *On Screen* (1972), for example, comments on the ways that bodies are found within and outside of the screen. Amelia Jones discusses the work in "Televisual Flesh: Activating Otherness in New Media Art." She describes a televisual work in which the camera telescopes out from various images of the artist, each nested within the others, "until, in the end, we realize we are watching two (or three?) televisual screens embedded in the monitor hovering in our space." This disruption of the frame, claims Jones, persuades the viewer to "begin to feel that we ourselves might be at any moment 'turned off' as part of an even larger televisual transmission, framed by a monitor we weren't aware of until now."[29] The nested bodies and spaces of the work threaten the situatedness of the viewer, who is finding their ongoing material embodiment against constant shifts in spatial situations generated by the screen. At the same time, the viewer is aware of their situated and stable body outside of these constantly shifting material relations. The reflexive body found by the viewer of Benglis' work is unstable, threatened by nested interactions within the space of her image and the space outside of it. Benglis' work exacerbates the process of finding the reflexive body against the ongoing process of materialisation of the other side, to such an extent that it unsettles the pre-reflexive directedness of self toward world.

This discussion has shown that embodiment has a dual role. As the perceptual centre, it plays a role in bringing forth materiality. This first role for the body is a "corporeality that is privileged as *naturans*"; a generative embodiment through which "productive difference and agentic capacity emerge."[30] The body is active in this sense, constantly participating in the process of materiality by enacted engagement with the world.[31] There is also a sense of the body as a reflexive recognition of a person's own 'inert' or situated materiality. The body in this second sense acts as a material residue which positions and places the self. The body is present both as a reflexive materiality and as separate from other reflexive materialities. A difference is opened that reveals the body at the same time as it reveals the body's excess.

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29. Amelia Jones, "Televisual Flesh: Activating Otherness in New Media Art," *Parachute* 113 (Jan. 2004): 72.
30. Coole, "The Inertia of Matter," 102.
31. Hayles has an interesting take on the role of human embodiment in materiality. She states: "Materiality for me is also a hybrid. But it's a hybrid between human cognition and physical characteristics." N. Katherine Hayles and Stephen B Crofts Wiley. "Media, Materiality, and the Human: A conversation with N. Katherine Hayles" in *Communication Matters: Materialist approaches to media, mobility and networks*, ed. Jeremy Packer and Stephen B Crofts Wiley (London: Routledge, 2012), 18. Cognition, for Hayles, is not separated, Cartesian function, but a "much broader cognitive function depending for its specificities on the embodied form in acting it." N. Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics*, Literature, and Informatics (Chicago: University of Chicago Press, 1999), xiv. In this way, Hayles defines a relation between materials that generates materiality.

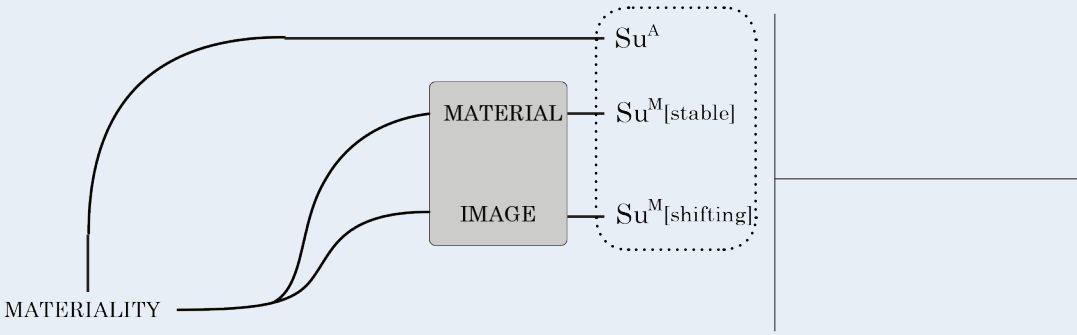

Fig 25. *Split Embodiment.*

Body and screen, screen and body

The dual role of embodiment is contingent on material processes in the same way as the 'inert' material of the object. Merleau-Ponty notes the contingent relation of body and material in saying that the world becomes available as an ambiguous relationship "between beings who are both embodied and limited and an enigmatic world… in which every object displays the human face it acquires in a human gaze."[32] The discovery of the material thing occurs alongside the discovery our own materiality. The material body, then, is one side of a difference in material relations. This conjoined nature of body and material is more than the body 'being made of' material – the body can only surface because the material world does, and vice versa.

An interesting complexity arises when considering this material reciprocity in terms of the screen. Whether a lattice or television, the 'other' side is generated as the screen surfaces as relata. With the lattice, this 'other' side is discovered as being divided; with the television, it is discovered as being produced. But neither pre-exists the discovery of the screen. The generative body finds two material relations – the material object of the screen and the materiality of the 'other' side. The object of the screen, the support or frame that has been cast out as relatum, appears as static. The reflexive body is found alongside this fixed object, which can easily become a perceptual relic of materialisation in a similar way to any other object. But the 'other' side continues to materialise as its static support remains unchanged. The movement of this produced space ensures it continues within the process of materialisation. The body remains generative within this space, it remains engaged in the process of materialisation. Yet the material object of the screen, and the reflexive body that arose with it, works against this ongoing materialisation. It sits outside of this relation at the same time as producing it.

The matter of the screen is in competition with the screen's ongoing use because it divides off a stable, fixed body from an embodiment that continues to be involved in a generative process on the 'other' side of the screen. The materiality of this produced and producing space counters the materiality of the static screen object (and so the fixed and stable body it corresponds to), constantly replacing it with a new relic of materialisation (each corresponding to a new body). This split between the static and the constantly refreshing needs to be remedied within perception, so that the person engaging can find a stable, situated reflexive embodiment. The body is found from within this second, ongoing materialisation at the same time as remaining outside of it with the screen—object.[33]

32. Maurice Merleau-Ponty, *The World of Perception,* trans. Oliver Davis. (London: Routledge, 2004), 69-70.
33. Vivian Sobchack describes this experience in cinema saying that the film, as an Other, stands both with and against the viewer. With, in the sense that the camera stands in for the eye of the viewer in joint experience; and against in the sense that there is something always missing that reminds the viewer of their lack of access. Vivian Sobchack, *The Address of the Eye: A Phenomenology of Film Experience* (Princeton: Princeton University Press, 1992), 9-10.

Material competition and the screen

The ways in which these two reflexive and ongoing materialities are resolved into a single 'object', and a single embodied context along with it, is dependent on how they arise and interact. Bruno's remapping of materiality approaches this kind of active materialisation across the television. She states that the materiality of stone, for instance, can be transferred to other mediums, such as film.[34] Experience suggests that the right image of stone can produce an emotive affect similar to the presence of the stone on the body. The perceptual mechanisms by which these two materials are found are similar. But it remains that the materiality of a virtual stone is supported by a different materiality.[35] This second materiality corresponds to a second reflexive body. Whether this difference results in a qualitatively 'different' materiality of stone, or whether this materiality can remains as 'stone', relies heavily on the context of the second materiality – it relies on the interaction between reflexively-found materialities of the screen. If this second materiality is, itself, active; if it does not disappear into the first materiality; it becomes harder to approach the materiality of the image as though it were the very thing it represents.

Niklas Roy delicately expresses the tension between the screen as 'inert' material and its role in generating ongoing materialisations in the space it separates in *My Little Piece of Privacy* (2010). Rather than fixing a standard privacy curtain across his workshop window to obscure the workshop from passers-by, Roy began to explore the relation of screening by obscuring the passers-by from the workshop. He did so by installing a "small but smart" curtain that uses a servo motor, surveillance camera and Processing to move along a track, following passers-by as they cross the window.[36] The installation disrupts a simple relation of the use of screening with a clear bias, deliberately expressing its use in an unexpected way. It inverts the idea of static screening by making a privacy curtain active. The screening is for the space rather than the passer by – the activity of the sliding curtain makes it clear that Roy's workshop is screening out passers by rather than being screened from them.

The object of Roy's curtain is no longer slow and fixed, but engaged with the body of the passer by. The ongoing materialisation in which

34. Bruno wirtes: "The material of stone does not disappear with the new media of modernity. Stone can have a different presence: its materiality can be transferred into the virtual forms of the photographic and the filmic. The physicality of the thing one can touch does not vanish when the tectonics of stone is gone, or when the time of celluloid has passed; it can morph culturally, transmuting into another medium." Bruno, *Surface*, 134.

35. Haptic visuality in this sense is defined in relation to optic visuality rather than touch itself. The materiality of the stone-image would, for example, be significantly different from that of the tectonics of stone, assuming Bruno is using the word in its architectural sense, should the person-stone encounter involve the making of a blunt instrument for hunting. Similarly, it is unclear whether an emotive effect such as 'solidity' or 'coldness' relies on stone's historical materiality – that is whether, if stone had always only been present as an image, 'solidity' and 'coldness' would present themselves as affective meanings.

36. Niklas Roy, *My Little Piece of Privacy*, accessed August 31, 2017, http://www.niklasroy.com/project/88/my-little-piece-of-privacy/.

embodiment is engaged is no longer within the space beyond the curtain, and beyond the window it sits in, but with the curtain itself. Roy reflects on this relation, saying that the curtain has failed because it is too engaged in its task, and that attracts attention rather than protecting Roy's privacy.[37] The curtain makes clear to the passer-by that they are a situated body by expressing an active and reciprocal materiality, which places itself alongside them. It is because of the curtain's activity that the materiality of the curtain comes into question. Because the second 'inert' material appears more actively than the ongoing materialisation of Roy's workshop – the space to the other side – it holds a greater influence over the 'subject' that is reflexively found within this relation.

A separate place?

Chapter one discussed the relata of the real and virtual as fundamentally different. The 'real' space to this side of the screen was separate from the 'virtual' space to that side of the screen. Considered in terms of the relation of materiality, however, both *this* side and *that* side of the screen are resolved into a single, reflexive situatedness. If the body is considered as a form of placement and positioning, and is found alongside the screen—object as well as alongside the screen—image, can these be considered as separate places? It makes little sense to discuss a spatial divide from within the material relation, as the 'virtual' arises from the same relation of materiality as the 'real'. The 'virtual' and the 'real' can be considered at the same time from opposite directions. Is the static world of determined relata – the reflexive body and the material screen – the real, and the generative space behind it the virtual? Or is the space divided off by the screen real because it persists in ongoing relational engagement, and the fixed material screen merely a virtual projection of this real process?[38] The screen as an object and the screen as a produced space are both real, both virtual, because their materiality is in both cases a matter of perceptual and relational engagement.

Considering the body as a person's materiality also has some interesting implications for generative materiality. Rather than the human being the centre out of which the material world is created, embodiment is placed on equal standing with the material. This is not intended to deny the role of embodied interaction in phenomenological worlding, but

37. Roy writes: "In the end, it does not protect my privacy at all. It seems that the existence of my little curtain is leading itself ad absurdum, simply by doing its job very well. My moving curtain attracts the looks of people which usually would never care about my window… My curtain is just engaged. And because of that, it fails." Roy, *My Little Piece of Privacy*.

38. The term 'virtual' is used differently here to our last encounter with it. In the first case – where the virtual refers to a generative space – the term is used to hold the same meaning as chapter one: of Friedberg's definition of the virtual as "possessing a power of acting without the agency of matter." Anne Friedberg, *The Virtual Window: From Alberti to Microsoft* (Cambridge: MIT Press, 2006), 8. In the second case – where the virtual is a projection of an underlying process – the term 'virtual' refers to things as we perceive them, to relata. The term is used in this second sense in a similar sense to Grosz's assertion that the real is constituted of a "plethora of vibrations and processes," and that this real is "carved out" into objects on which we can act. Elizabeth Grosz, *Architecture from the Outside*, 175.

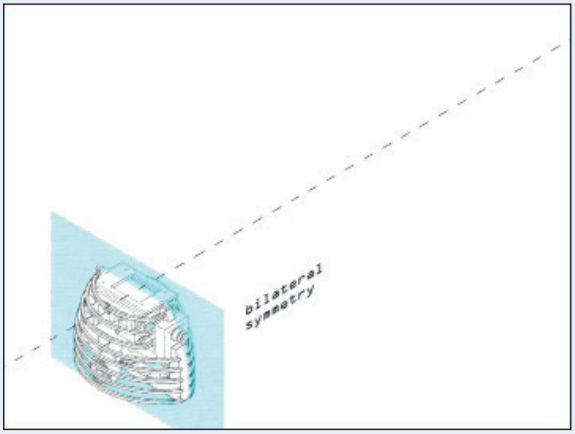

Fig 26. *Thing-driven Aesthetic*. [Video, 00:16].

"Even the humblest forms of matter and energy have the potential for self-organisation"

Jane Bennett[43]

Autopoesis

Can objects form themselves? What are they before they form themselves? Autopoesis is a mechanism reserved for the lively, things that develop and maintain themselves. Cells respond to hormone gradients and differentiate to form organs. They make more cells and remain cells, but they remain cells of organs. The autopoetic thing uses its environment for its self maintenance and self growth, it organises itself.[44]

A thing that shows autopoesis is for-itself, has a stake in bringing itself about. Does the designer interrupt the thing in wilfully swaying it away from itself, in causing it to develop it differently?

Moubie wasn't exactly brought about by me, though I asked certain things of him to begin with. I asked him to express and communicate his own relation to space. *Moubie*'s 'organs', his components, were determined from these requests: wheels to move, a motor to drive them; a camera to see, LEDs and an LCD to communicate. I

instead frames this role as itself contingent on a relation of materiality. As well as bringing forth the world, the body is brought forth along with the world. As Bennett succinctly states, "what is manifest arrives through humans but not entirely because of them."[39] The embodied human, as the epicentre of the world, does bring forth the world as relata by ordering. But ordering can only happen across a difference.[40] The relational world of generative materiality first brings forth this embodied human as a difference, and the world which is available to be divided into relata is brought forth along with it.

Lively materialities

Through this discussion, materiality has been positioned as having a productive force, in that material differences produce distinct forms of the material from within material relations. For Coole, this productive force is generative in its self-organisation – she connects generative materiality to a "lively process of self-formation" that arises from an "immanent and irreducible relationship between creating and created." Coole does not make a clear distinction between nature and materiality in her discussions, occasionally conflating the terms into the hybrid "nature/matter."[41] Her use of terminology makes clear that her approach is not to distinguish between the organic or inorganic, nor between the lively and the unlively when discussing the generativity of matter. Bennett adopts a similar stance in her description of "thing-power," which she believes "draws attention to an efficacy of objects in excess of the human meanings, designs or purposes they express or serve." The generativity of matter is not limited to the human, or even to the 'alive', in Coole's and Bennett's views, but comes from a materiality that "is as much force as entity, as much energy as matter, as much intensity as extension."[42]

39. Jane Bennett, *Vibrant Matter: a political ecology of things* (Durham: Duke University Press, 2010), 17.
40. DeLanda equates ordering with a holding apart of difference, remarking that temperature difference is a result of a highly ordered distribution of molecules: "that is, they are neatly sorted out into two parts, one hot and the other cold. At the end of the process the entire population is uniformly warm and this order has disappeared." Manuel DeLanda, *Philosophy and Simulation: The Emergence of Synthetic Reason* (London: Bloomsbury, 2011), 8.
41. Coole, "The Inertia of Matter," 97-8.
42. Bennett, *Vibrant Matter*, 20.
43. Bennett, *Vibrant Matter*, 7.
44. Heidegger indicates that things always have a role in bringing themselves about, he defines the "essence" of things as the way in which they "hold sway, administer themselves, develop and decay." Heidegger, *The Question Concerning Technology*, 30.

asked him to be slightly bigger than my hands, and to have bilateral symmetry. I asked these things because they seemed to work toward a screen-for-itself, a screen that had some form of agency that arose from its material directedness toward space.

These components then developed into *Moubie*'s form. Each component had its own directedness toward space – a camera that pointed forward, LEDs and an LCD that pointed upward toward the human eye, wheels that contacted the ground and a motor that sat above them. They were organised along an axis of symmetry and supported in their orientations by a skeleton, which held each of them in the closest possible relation to the others.

The size of *Moubie*'s LCD formed his depth at the peak as well as his length. The axle length between his wheels arose from the motor's turnplate and formed his width at the base. His skeleton then developed from layers of lasercut 3mm ply. As these pieces began to lock into each other, the thickness of his skeleton was formed, along with the aesthetics of his appearance. *Moubie* is made out of an antiaesthetic. He is driven by his components and his skin remains unformed and unfinished. His form is simplified and open-ended.

My initial requests were oriented toward a thing that expressed tendencies of being for-itself. I am not absent from this process, my design decisions influenced the coming about of *Moubie*. However, there are moments in this process where I was *used*, where the orientations of *Moubie*'s components and relation to space had a larger stake in his coming about than my desires for his form and function. Are these moments a form of autopoesis?

Things have a capacity that is separate from the intentionality of humans, that has "propensities" and "tendencies" of its own.[45] Bennett borrows Hent de Vries' term "recalcitrance"[46] to describe this excess of materiality, a term that is particularly apt due to its almost wilful, stubborn overtones, and for its strong sense of material substance. Things gain this recalcitrant capacity through materialisation, just as humans gain their capacities for action through this same process.

LAb[au]'s *Framework 5x5x5* (2011) expresses this type of screenic recalcitrance well. The screen is composed of five modules of a fixed five by five grid frame. Within each frame, two rotating frames also move – the outer rotating vertically and the inner horizontally. The grid is conceived as the screen's resolution, its capacity for carrying information. The information it carries, however, is not directed toward human intent in the traditional sense. The inner frames, lacquered black and white on opposite sides, rotate between these binary states like the opened and closed logic gates of electronic technologies. Each frame is additionally side-lit with LEDs that can show red or white. The result is a complex pattern created from simple binary states: open and closed, moving and still, on and off. The screen does not carry information for use, but is "the expression of digital logics through an artistic and sculptural vocabulary." The screen acts to translate the material directedness of screens, the "language of technology,"[47] into a human language. The screen asks to be understood by the people with whom it interacts – it displays the way it is directed toward the world. The result is somewhat ominous – the screen appears as a large, ordered and complex form that asks something of us, but what it asks is undefined.

45. Bennett, *Vibrant Matter*, viii.
46. Hent de Vries uses the term 'recalcitrance' as a signifier for the absolute, for "what no speaker could possibly see, that is, some-thing that is not an object of knowledge." Bennett, *Vibrant Matter*, 3.
47. Lab[au], "F5x5x5" in *A Touch of Code* (Berlin: Gestalten, 2011), 193.

> Actually, a fourth mode of 'breakdown' should be added to Heidegger's threefold of conspicuousness, obtrusiveness, and obstinacy. Certainly in times of rapid technological change and development we are quite often confronted with this. One might call it 'unfamiliarity,' and we're forced to deal with this phenomenon head-on each time we start using a new or unfamiliar tool or technology. Sometimes this goes quite easily… other times it involves a lot of painstaking hours in front of a user's manual.
>
> *Yoni Van Den Eede*[48]

What does it do?

The unfamiliar extends the time spent in relational flux, as we try to collapse the indeterminate into something determinate. When you first see *Moubie*, you might ask something like "so, what does it do?." You might try to resolve its purpose, its form and behaviour, toward your own intent. To see it as something to be used. Screens act towards humans and toward human environments. They mediate spatial relations for humans in a way that benefits them – that allows them access to other spaces or defends a space they call their own. We desire them to do this. It is difficult to resolve this intent for *Moubie*. He seems to have some of his own intent, a kind of directedness toward space. He moves at a certain pace and in a fixed, habitual way. But he is also trying to communicate something, he is making his directedness clear to you. How can this be used?

Perhaps, instead, he stands apart from use, his main role is in communicating. Perhaps he's interacting with the environment of his own accord and trying to express himself to you. In this case you might ask how he avoids things, or how he decides to move backward or forward. But I know that he doesn't really decide or avoid. He doesn't act for himself, for you or for me. *Moubie* isn't a screen or a tool or a communicator. Just a thing.

in this engagement. As both are the product of a process of materialisation, each is wholly dependent on the other, not simply reflexively, but generatively. However, it also means that the materiality of both the screen and the person will be reconstituted, and constituted differently, in each encounter as the process of materialisation recurs anew. In as much as the process is generative, it makes no more sense to say that a person can 'use' a screen than it does to claim that the screen 'realises' a person – that it exhibits an influence over the way that the person is realised through material relations. In this way, the screen in its materiality is "both self-constituting and invested with – and reconfigured by – intersubjective interventions that have their own quotient of materiality."[49] The screen object can reshape bodily being, introducing new gestures, actions and understandings, just as a person can reshape the materiality of the screen object.

Material arises as an active process of materialisation, not a "massive, opaque plenitude," but as "constantly forming and reforming in unexpected ways."[50] This is an effective process, it causes material to happen, and simultaneously brings about people, contexts, references and opportunities for action. This effectivity suggests a type of agency to the process. Although materiality

Material agency

Generative materiality also helps to develop a processual approach to agency. If materiality itself is generative, then agency exists before the subject and object, between different materialities. If the primacy of the generative material relation is to be taken as the basis of analysis of an engagement between a person and a screen, then it follows that both the person and the screen have their own stake

48. Yoni Van Den Eede, "In Between Us: On the Transparency and Opacity of Technological Mediation" *Foundations of Science*, 16 (2011): 143-4
49. Coole and Frost, "Introducing the new materialisms," 7.
50. Coole and Frost, "Introducing the new materialisms," 10.

and agency are held separately in a relata-based analysis, from within relations material itself is agential – it generates and affects. It is unclear, however, whether this material agency can be considered in the same terms as the political agency of the subject as relatum; whether it is the sort of agency identified with alterity, or something of a different kind. To resolve the role of material agency more fully, I will now turn to a reframing of agency along the same lines as this discussion of materiality – agency as a generative difference.

Agency, agentialisation and the screen

Agency was also held as a fundamental difference in relata-based analysis – a difference that expressed the separation of the subject from the object. Agency was a property that defined the subject and was refused to the object, showing a clear directionality. This section will define a different sort of agency as it belongs to screens. It will begin by using Coole's article "Rethinking Agency," which poses a de-individualised political agency based on agentic capacities. It will then discuss these agentic capacities against screenic examples to define the qualities of a processual agency that can generate active materiality as well as active subjectivity. It will conclude with a discussion of prolonging the moment in which agency is determination to reveal an active, agential screen.

Capacities for action, not intent

Coole posits political agency as a spectrum of scaled emergences – of capacities for action. She insists that these "agentic capacities" are not the properties of the subject *per se*, but "are only contingently, not ontologically, identified with rational, individual agents."[51] She defines three attributes – potency, reflexivity and motivation – which she uses as agential markers "while denying that such agentic properties entail a specific ontological assumption as to whom exercises them."[52] Potency, reflexivity and motivation are concerned with the ability to bring about effects, be concerned with their nature, and to show an attitude towards these effects respectively. Coole then demonstrates these capacities across three scales – pre-personal, singular and trans-personal – to show agency as it arises within these contexts.

Coole's schema is intended to demonstrate that agency is not a by-product of subjectivity – that it does not 'belong' to the subject. The agentic spectrum she describes implies that agency arises out of situations, it is a process rather than a property. Although Coole does effectively demonstrate the de-individualised nature of political agency, thus loosening agency from issues of intent and will, she retains a sense that agency belongs to the realm of the human. In her aim to decouple issues of intent from action, she retains a particularly

51. Diana Coole, "Rethinking Agency: A Phenomenological Approach to embodiment and Agentic Capacities," *Political Studies* 53 (2005): 124-5.
52. Coole, "Rethinking Agency," 125.

"Things… [signal] the moment when the object becomes the Other, when the sardine can looks back, when the mute idol speaks, when the subject experiences the object as uncanny and feels the need for what Foucault calls 'a metaphysics of the object'"

Jane Bennett[54]

Warning signs

Gaze Returner is noticing something about his relation to space and to me. He is reflecting on this relation and forming an opinion. He is communicating this opinion to try and bring about an effect. *Gaze Returner* is warning me. He knows I'm here, he knows I'm getting closer and he's trying to stop me. What does this warning mean?

The warning is a strange kind of interaction. It is both an acknowledgement and a denial, passive and active, a communication and an effect. It indicates a desire that is not being met, an action that must be fulfilled by another. But *Gaze Returner* is just a screen flashing different colours at me. It isn't a warning, it has no intent.

human intonation to agency – she outlines an agency that is "irremediably embodied."[53] The pre-reflexive and situated nature of embodiment opens questions in regard to such reflexive capacities as subjectivity. However, if agency is considered as a generative force in the context of the screen, it needs to be able to generate the agentic object as well as the subject; or, more generally, it needs to be able to generate agentic *material*.

To apply this schema to an understanding of the screen, emerging agentic capacities need to be recognised as material rather than embodied. In the last section, the body arose as a pre-reflexive generative entity with a certain directedness alongside other, nonhuman entities with similar types of directedness. Materialisation was seen as an interplay of these undefined material capacities. Agency could be defined similarly if agentic capacities could be seen as arising from pre-reflexive materialities rather than purely from human bodies. To develop the idea of material agency further, Coole's agential capacities of potency, reflexivity and motivation need to be considered in terms of the material rather than the political. Coole's discussion of transpersonal agency gives some insight into how this framework might be extended into the material realm to look at agentic capacities that emerge within objects.

Potency and efficacy

Coole remarks that the potency of the transpersonal domain lies in its "transformative efficacy,"[55] its ability to generate effect without individual intent. Of the three of Coole's agentic capacities, efficacy is perhaps the most directly applicable to material agency. Ihde and Verbeek have shown in detail the capacities of objects to affect change "by virtue of their materiality: their concrete 'thingly' presence."[56] The use of tools, particularly, shows the ability of things to bring about material effect. In this sense, the material efficacies of the screen can be recognised in the ability of its material to support its function. In this case, the lattice's actions as a barrier can be assigned to the strength of timber and its ability to be carved. The television's actions in representing space can be seen as a by-product of the pixel and its ability to translate information into coloured light.

53. Coole, "Rethinking Agency," 127.
54. Bennett, *Vibrant Matter*, 1.
55. Coole, "Rethinking Agency," 140.
56. Peter-Paul Verbeek, "Artifacts and Attachment: A Post-Script Philosophy of Mediation" in *Inside the Politics of Technology: Agency and Normativity in the Co-Production of Technology and Society*, ed. Hans Harbers (Amsterdam: Amsterdam University Press, 2005), 129.

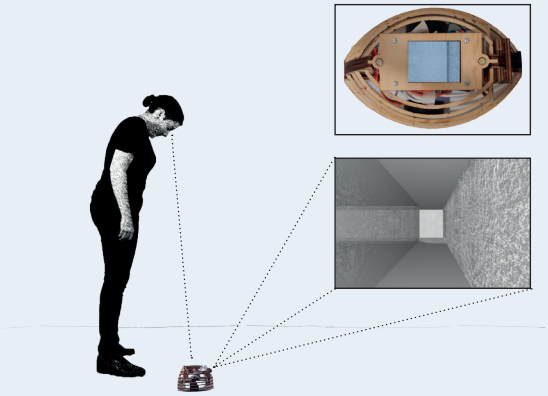

Fig 27. *A Different Perspective.*

"To qualify as a 'real' actor in the drama, the agent has to be able to preserve its own identity and defend itself against encroaching foreign elements. The winners are those actors who can subvert and co-opt another's agency while keeping their own intact"

N. Katherine Hayles[58]

Hijacked perception

As I share space with *Moubie*, I find myself more interested in what he's doing. His movements, his flashing lights and his simple repetitions of process engage my attention. He seems to be trying to communicate with me, to tell me things about what he is doing and what he sees. I put my head down and follow alongside him for a while; watching his screen as it updates, seeing what he sees.

When I look up, I notice that I've been seeing from his point of view and at his pace of seeing, because I've returned now to my point of view and my pace of seeing. His demeanour has very quietly hijacked my relation to space, persuaded me to see things from his perspective. I've been attending to him as a person, as something which sees, reflects and communicates.

While it is fairly accepted to claim that things affect things materially (this is, after all, why they are useful), Bennett likewise notes "the capacity of things… to impede or block the will and designs of humans" with a "not-quite-human capaciousness"[57] that is independent from subjectivity. The material of things can act against people or independently from people as well as for them; in this sense, material shows an efficacy independent from the subject. Such a material efficacy can be found when the remote control no longer changes the television channel or when the computer suddenly displays a blue screen of death – these are signs that the screen is no longer working for the human.

57. Bennett, *Vibrant Matter*, viii; 3.
58. Katherine N. Hayles, "Desiring Agency: Limiting Metaphors and Enabling Constraints in Dawkins and Deleuze/Guattari," *SubStance* 94/95 (2001): 150. Hayles is speaking here of Richard Dawkin's conception of agency in *The Selfish Gene.*

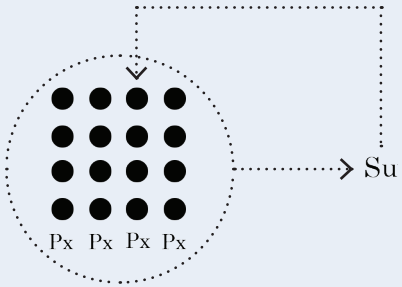

Fig 28. *Scales of Action.*

Reflexivity and reciprocity

The adaption of reflexivity as a material capacity provides a greater challenge. The capacity for reflection is strongly linked to subjectivity. Coole remarks that the transpersonal domain is reflexive in the sense that it shows "a certain… interiority, where collective life turns back on itself."[59] Agential matter, then, should be able to 'turn back on itself' to contribute to its context in a way that creates interiority.

Daniel Rozin's series of works *Mechanical Mirrors* demonstrates such an understanding of materiality reflexivity. Rozin's earliest piece in the series, the *Wooden Mirror* (1999) relies on the reflection of light on a tilting plane to compose an image. A series of wooden tiles organised in an array are connected to motors which tilt them up and down to reflect an external light source. A camera mounted in the front of the mirror feeds an image to an external processor, which is processed into greyscale and mapped to an angle, so that white pixels correspond to a thirty degree tilt upwards toward a light source, and black pixels to a thirty degree tilt downward and away from the light source.[60] The resultant image is mediated specifically by the timber's materiality: its ability to cast shadow and reflect light, as well as the natural colour and size of the wooden pixels, affect the fidelity of the image. Rozin has translated this system into other materials, all of which mediate the image differently. *PomPom Mirror* (2015), one of the most recent of the set, relies on the compressibility of wool to pull black and beige "fur" pixels past each other. The resultant image is of a different kind because the materiality of the pixel is distinctly different.

Although these pieces are called 'mirrors' they are not reflective in the traditional sense. Yet, the person interacting with these mirrors is shown to themselves in a way that is translated by the specific materiality of the pixel and the workings of the system behind it. In separating what is received from what is displayed, the system turns back to itself to present a person to themselves in a different material form. The mirror's turn back into its context generates new capacities of action – people test their movements against the mirror, and in turn the mirror recomposes their movements in wood or fur. The mechanical mirrors see and reflect upon the materiality of bodies by reciprocating those bodies with their pixel's materiality. The mirror reciprocates the action of the person with its own action.[61]

59. Coole, "Rethinking Agency," 140.
60. Rozin discusses the technological system behind the mirrors in a video entitled "Interactive art with wooden mirrors', accessed 30 August 2017, https://www.youtube.com/watch?v=BZysu9QcceM.
61. Reciprocity of action lends a particular reading to the ability of things to turn back on themselves, but the generation of action from action is well noted. Grosz conceives of freedom as the "the ability to act and in acting to make oneself even as one is made by external forces." Elizabeth Grosz, "Feminism, Materialism, and Freedom" in *New Materialisms: Ontology, Agency and Politics* ed. Dianna Coole and Samantha Frost (London: Duke University Press, 2010), 142. In doing so, she identifies a multidirectional role in acting and being acted upon, making and being made. Allen notes similar themes of reciprocity in the agencies of Foucault and Arendt; and Bennett discusses the same in Deleuze's work.

The kind of material reciprocity shown in Rozin's work constitutes a reflexive turn in the sense that it ensures that anything that acts is also, simultaneously, acted upon. Reciprocity ensures that actions are, in a sense, never without consequences – that a system that acts towards its environment is always acted back at. The contextual changes that arise from this dual action affect the possibilities for further action. In this sense, reciprocity can define a material reflexivity: actions made turn back on themselves by altering their environments, affecting the scope for further action.

Motivation and directedness

The last of Coole's agentic capacities, motivation, is usually considered in terms of will or intent when linked to the subject. In her analysis, Coole states that, although the transpersonal domain does not show intent in the individualised sense of the word, it does show a "contingent *sens* because it is an intersubjective domain where desires and refusals meld and congeal."[62] She uses the term '*sens*' to mean a form of direction or directedness. Although Coole's trans-personal domain does not display a cogent or singular intent, it is directed towards certain actions and aims. Within the material realm, a similar directedness could be found in a form of material intentionality.

Don Ihde discusses the material directedness of technologies in terms of *technological intentionality*, saying that "technologies, by providing a framework for action, do form intentionalities and inclinations within which use-patterns take dominant shape."[63] Although Ihde applies technological intentionality toward the use context, the statement indicates that technological intentionality arises from a form of material directedness.

Wier, for example, introduces a screen with specific material directedness in a 1969 issue of *Leonardo*. Wier describes a kinetic art technique based on chemicalical interactions, in which a watch glass containing a "starting solution" is placed on an overhead projector. The starting solution is slowly infused with various chemical solutions which, when interacting, produce coloured patterns. These patterns are projected onto a white wall as a moving image. Wier's screen and its effects rely on the specific material directedness of the chemicals used and the relations between them. As Wier states, knowledge of chemistry is essential to the operating of his screen: "an operator should… learn the nature of the chemical reactions that can occur between the starting solution and reactive additives, in order to choose the type of effects he wishes to produce."[64] As the chemical reactions take place, motion is generated within the solution, creating a screening that is intensely material.

62. Coole, "Rethinking Agency," 140.
63. Don Ihde, *Technology and the Lifeworld: From Garden to Earth* (Bloomington: Indiana University Press, 1990), 141.
64. D. R. Wier, "Light Shows: A Kinetic Art Technique Using Chemicals," *Leonardo* 2, no. 3 (July 1969): 254.

"If the holding is done by the jug's void, then the potter who forms sides and bottom on his wheel does not, strictly speaking, make the jug. He only shapes the clay. No- he shapes the void… From start to finish the potter takes hold of the impalpable void and brings it forth as the container in the shape of a containing vessel."

Martin Heidegger[67]

"There are many practical and conceptual obstacles here: How can communication proceed when many members are nonlinguistic? Can we theorise more closely the various forms of such communicative energies? How can humans learn to hear or enhance our receptivity for 'propositions' not expressed in words?

Jane Bennett[68]

Unintentful design

Things exhibit their own intentionalities. But if the design process is predicated by designer intent, how can design access the intentionalities of things? How can I start at the end of a process of materialisation, with a sedimented idea of the object and its use, and work in to the relational field?

It is difficult to access this momentary field, these relations in flux, which may be in contrast with the reflexive relata. The role of design and the intent of the designer are challenged by such an aim. Perhaps the best I can do is negotiate – recognise the unintended as the thing designing back, communicate with the developing object as it brings itself about.

Making with Arduino is like communicating with the thing as it develops. A text-based interface is provided for carrying meaning between human and microchip with a grammatical structure similar to that of human-human languages; where individual morphemes are combined into statements according to a syntax. The microchip performs acts of semantic translation on this communication to carry it forward to networked components, using fluctuations in voltage over time to 'read' and 'write', producing action and information.

Determining agency

Material directedness is not necessarily at odds with human intentionality.[65] Having shown confluences between the embodiment and the object as recognitions of materiality or placedness, Merleau Pontys description of morticity or pre-reflexive movement as "original intentionality"[66] makes clear that bodies, too, show material directedness. Bodies are composed in a certain way that renders them directed toward certain things prior to reflection.

If material agentic capacities are considered in terms of efficacy, reciprocity and directedness; it becomes possible to see the screen as an agentic thing. This agentic screen is not considered as ethicopolitcal structure, but as a form of material efficacy. That is, it is not the sociopolitical consequences of its actions that are under consideration, but the material consequences of those actions. Agency, in this sense, is contingent not only on the material, but on differences in materiality. Such an approach separates any resultant agency—as—relatum from belonging purely to the domain of the subject. It allows material agency to be revealed, but it does not disallow a subject-bound agency from appearing. In other words, the process of agentialisation arises across a difference in material directedness, generating reflexive things that are considered to have, or lack, agency.

65. The affordance framework discussed in chapter one shows how material directedness of things can be co-opted for human purposes, to expand and alter human capacities for action.
66. Merleau-Ponty, *Phenomenology of Perception*, 139.
67. Martin Heidegger, "The Thing," 167.
68. Bennett, *Vibrant Matter,* 104.

These communications are not hierarchical and unidirectional. The microchip is not the mediator between the human's intentionality and the action performed: human to microchip to components. The communication between microchip and components (which can be both written to and read from) is not so clearly directional. The language of effect, whose morphemes are voltage and time as well as words, lies between components and microchip. Action too carries meaning that feeds back in to the communication process, between actuator and designer. Words, voltage and action become morphemes form a system of communication in which spatial effects occur.

Coming to know the machinic syntax, and the ways in which meaning is produced using it, is a process of actively listening to machinic intentionality. Not a (human) design intent, but its ways of doing, its ways of communicating. This syntax is clearly directed toward the world in a particular way, a way that I have to come to understand. The links between basic units of meaning; words, voltage and action; are left exposed in the Arduino interface. Mistranslation can occur. These are not distinct and defined entities – human, microchip, component– using three distinct communication systems. They are a material directedness. In the iterative process of designing with Arduino; actions, electron differentials and words are all instructions *and* effects. Humans, microchips and components are all effectors, translators *and* mediators.

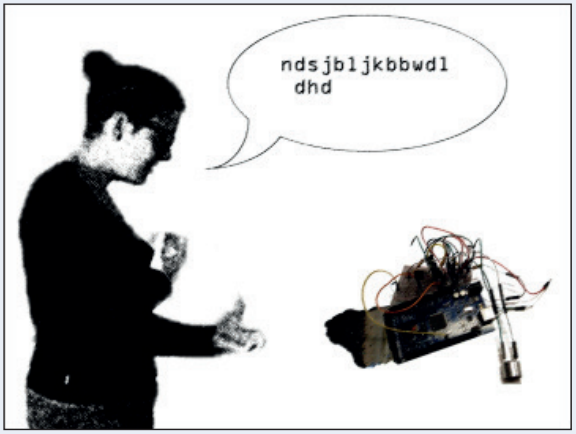

Fig 29. *Negotiations.* [Video, 00:10].

Although not entirely grounded in the agency of material, Takayama's discussion of agency in human-robot interactions might show how such a nonhuman agency could be recognised. Takayama approaches object agency as a quality held in immediate, "in-the-moment"[69] human perception; not as an intrinsic quality of the object itself, nor as a summative or reflexive meaning that informs the conditions of possibility of an object. She states that it is the perception or recognition of agency that influences a person's actions toward an object regardless of the existence of agency as such. Such an approach suffers from the assumption that agency is something granted by an individual subject rather that being itself generative of subjectivity. Takayama seems to note this in denouncing ontology, stating that "while it is possible to argue at length about the ontological status of an entity's agency, it is also possible to define agency as something that is perceived."[70] Despite addressing agential materiality through subjectivity, Takayama's approach indicates a reflexive overwriting of experience, where objects reacted to "in the moment" as if agentic will later be denied agency in reflexive thought. She seems to recognise agentic material capacities, even if they are subsequently overwritten by reflexive human intent. The reflexive process that Takayama posits can be likened to the process of determining relata. If, before this moment, agential material may be recognised, and afterward it may not be, this is the moment in which agency is determined as the property of a relatum. It thus also corresponds to the moment at which the subject and object are determined as relata, as being able to hold properties. Before this moment of reflexive thought, the subject and object are indeterminate and agency remains as an ongoing process in which efficacy, reciprocity and directedness are differentiating into entities.

The subject-like agency of things is demonstrated well by Random International's *Audience* (2008). The installation suspends the moment of finding the subject and the object even as the subject is presented to themselves. The piece is composed of a "horde" of small mirrors, arranged at floor height on metal feet and motors that allow the mirror face to

69. Leila Takayama, "Perspectives on Agency Interacting with and through Personal Robots" in *Human-Computer Interaction: The Agency Perspective*, ed. Marielba Zacarias and José Valente de Oliveira (Berlin: Springer, 2012), 196.
70. Takayama, "Perspectives on Agency," 195.

tilt and turn. Without a human interactant, the mirrors move in a seemingly unorganised fashion. As a person approaches, motion tracking software informs each mirror of their position, and each mirror turns to focus on the person. The movement includes the titling of the plane toward the person's face, so that the person is confronted with their own image at a variety of distances.

Audience allows the human interactant to see themselves reflected even as they are reminded of what is doing the reflecting – linking the image of the self to the object. The "inquisitive, synchronised gesture" with which all the mirrors turn at once toward the person, and their smooth "sense of abstracted, human-like behaviour"[71] suggest an efficacy and directedness; and the individuality with which they react to the person as their focus suggests a sense of material reciprocity. The *Audience* expresses a subject-like agency. This agency is not properly located within any of the mirrors, nor perhaps in the mirrors as a whole, but somewhere behind what might otherwise have become the subject and the object. Although the human is presented to themselves as the focus in becoming the subject of the artwork, they come to objectify themselves within their own gaze. The mirrors in this context cannot wholly be seen as objects, either, as they have borrowed the gaze of the viewer, who "becomes the subject of their own gaze and that of the artwork."[72] The effectiveness of *Audience* as a performance lies in its ability to suspend the moment of subject-object collapse. Agency is revealed here as a non-directional process that can reveal an agential object as well as an agential subject.

Materiality agency and the body

In the sense that the screen arises from generative material and agential relations, it is not something which stands against a person as an object against a subject; rather it arises with the subject, and does so in a way as to highlight situatedness. Although the determination of subject and object is an unavoidable, if complex, perceptual process, it is also reflexive – based on a process of finding agencies across differences of material capacities. The screen surfaces as new possibilities for action in space become apparent, agencies that are themselves contingent on the material capacities of the particular screen. These agencies not only influence how the screen appears and is negated by the materialities it produces, but also how the efficacies and materialities of the person appear within the relation.

The material agencies of the screen appear similarly to a person's embodiment – as a certain directedness in generating material and agencial relations – only to be overwritten later by a reflexive object called a 'screen'. In this sense, there is a directedness or fixity belonging to each screen which influences materialisation and agentialisation – the

71. Random International, "Audience," accessed August 30 2017, https://random-international.com/work/audience/
72. Random International, "Audience."

> The surface of the screen as a hybrid material ... renders and accrues the discontinuity of time, the surface gives us back not only the experience of temporality but of subjectivity, and that such a space of experience is a foundation of the materiality of media.
>
> *Giuliana Bruno*[74]

A screen's directedness

What are the material intentionalities of screens? Each screen has a different material, a different way of coming about. Can there be something in common to these materials that reveals a directedness?

Screens are spatial, they are directed toward space. But they are, more particularly, a recognition of a difference in space, a spatial difference that they are intimately connected to. The screen, in use, remaps distance, time and materiality. But this use is indicative of a particular directedness, a particular intentionality towards the ordering of space.

Moubie orders space within a repetition of time. He sees and displays in regular cycles. His ordering of space is bound to *his* pace, and this reveals space as it is for-*Moubie*, a space screened through *Moubie*'s pace. His reordering of space, then, is bound not only in his seeing but in his processing and communicating. *Gaze Returner* also orders space, but does so in terms of a relation between himself and you. His space is ordered in terms of the distance between you, it is a space that orders approach into colour and image. What remains as 'screen' in these things is not their agencies or their impact on the subject, not their ability to threaten or distract, but the spatial ordering that they undertake.

What of more familiar screens? Televisions and phones hear electromagnetic signals, re-order them into visual signals and communicate them as light. Cinema reorders chemicals laid on film into coloured light, lattices order continuous space into a marked division. Order is seen strongly within the composition of screens. Lattices gains their directedness from the repetition of apertures, cinema from the pace at which the frame moves through the projector, televisions from pixels fixed in an array.

Screens are found in order and out of order, directed towards space in the ways that they order it..

screen helps set relations in place. Echoes can be found here of descriptions of the screen as a frame, but also in its role in enframement. The two terms are linked in a type of processual fixity, the first a reflexive acknowledgement of material influence and the second a pre-reflexive process which fixes the way material comes about.[73]

73. In framing, space is effected by the frame's material efficacies as the screen produces the image according to a fixed, material process. The pixel, in this regard, has a different mode of spatial production to the aperture or film.
74. Bruno, *Surface*, 108.

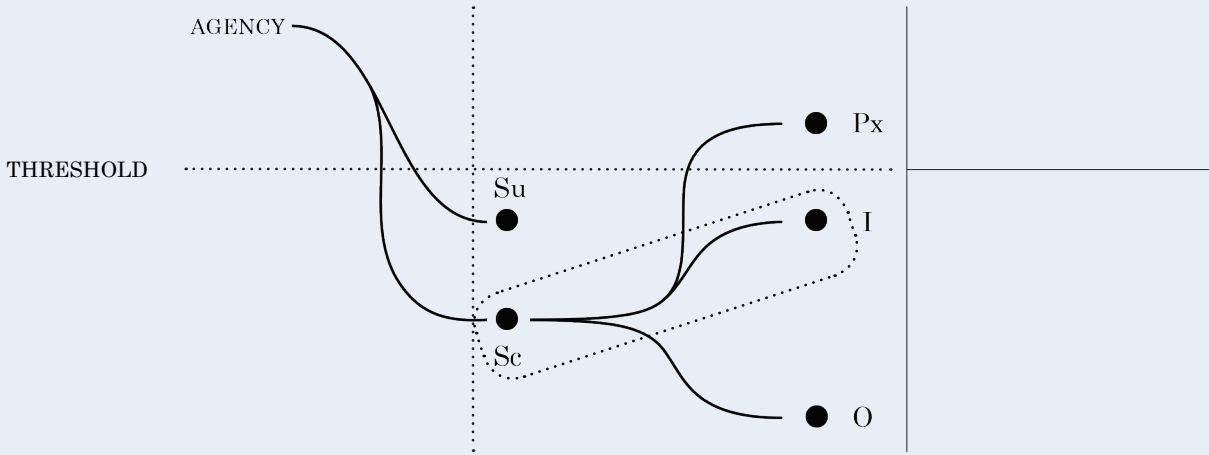

Fig 30. *Perceptual Thresholds*.

Thinging and relata

Having established materiality and agency as processes that affect how the screen arises, I will now consider the mechanism by which the screen is defined as a thing – that is, how these generative processes are turned into discrete, determinate relata like the screen. This section will begin by establishing a contradiction between generative relations and the screen as a relatum. It will then discuss how the screen relatum might be determined from these relations, before defining its excess; an excess that is screenic, but does not belong to the screen *per se*.

So far, this chapter has found that the material and agential properties of the screen are reflexive characteristics generated by active relations. Their reflexive differences are rooted in the subject-object dichotomy. Conventionally and reflexively, the property of agency belongs to the subject, to my ability to act (intentionally); whereas a passive materiality belongs to the object, to be acted upon. However, the emergence of materiality and agency – materialisation and agentialisation – hold much akin if looked apart from this reflexively imposed dichotomy. Materiality and agency are determined together from within processes across differences, so that what arises is what it *is*, what it *can do*; and what I *am*, what I *can do* – both inherently situated and contextual. Agentialisation and materialisation result in the contemporaneous emergence of the material and the agential as properties, and along with them the subject and the object, the real and the virtual. From this perspective, viewing materiality (and, indeed, screens) as inert or inagential segments off and ignores part of the very process by which a thing is called a thing.

Relational disappearance

The screen of the last chapter, which disappeared into the subject or the space, can now be approached from within the relations of materiality and agency to find a mechanism by which it can disappear. Perhaps the most immediate apparent explanation for the screen's material absence is that it never surfaced as a relatum– that materialisation and agentialisation resulted in the real and the virtual, the subject and the object, without the 'screen' at all. But such an approach would again leave questions of what it was that disappeared, and of what it is that is called the screen in the first place. Some screenic recalcitrance persists against these claims. Instead, it may be the presence of some sort of fundamental contradiction between the screen as it surfaces in perception and the accepted collapse of materialisation and agentialisation into materiality and agency that can explain the screen's negation. The ontology of the screen resists itself, implying that the screen is produced from materialisation and agentialisation in such a way that its active materiality interferes with determining an 'inert' object: the boundaries drawn around its effects do not allow it to be seen as inert material, but as a productive force.

To explore this contradiction further, and to find an avenue by which to understand the screen closer to its generative relations, I will discuss two similar but varying positions on the coming about of things from relations: Heidegger's 1950 lecture "*Das Ding*," translated as "The Thing" in 1976; and Grosz's 2001 essay "The Thing," which, although it does not reference Heidegger's essay of the same name, shows similarities in approach, if not outcome.[75]

Finding things

In "The Thing," Heidegger approaches things according to the process by which they arise. A thing is a setting in place and setting of place, a gathering of spatiality and temporality.[76] The thing, in this sense, is a process rather than something static; it unifies and reveals the world by drawing the world near. Grosz considers the thing in similarly processual and spatiotemporal terms. She makes particularly apparent the mutual dependence of person and thing as "inaugurated at the same moment" – the thing as "the resource for the subject's being and enduring."[77] For both, the finding of relata, of 'things', in perception is an act that orders the world along certain lines. Embodied perception, as a form of human material directedness, is immersed in a relational flux, which it then orders according to our intentionality. This ordering reveals things. Things, then, are revealed from relations in line with human intentionality; they are revealed according to how they are of concern *for us*.

The way that things are determined as relata is contingent on this process; things are revealed in perception as they are of concern to our contextual involvement. Heidegger refers to this process as 'drawing near'. Nearness, here, does not mean proximity: "the thing is not 'in' nearness, 'in' proximity, as if nearness were a container. Nearness is at work in bringing near, as the thinging of the thing."[78] The 'near' of the thing is not its proximity in Cartesian space, but its nearness to the interest or directedness of the world. In this sense, nearness can equally present things as far, as long as they are contextualised within human concern.

This process of drawing near has its own reciprocity. In this directedness, thinging reveals the person to themselves, in the way that space and time are ordered for them, as much as it reveals the material. Directedness is revealed at the same time as the thing towards which that directedness is pointed. Hence the object, that which is drawn near, is found alongside the subject, "that-which-lies-before, which, as ground, gathers everything onto itself."[79] But this process is only authentic

75. Grosz's essay appears as a chapter in *Architecture from the Outside*.
76. Heidegger's 'fourfold' of earth and sky, divinity and mortals, have distinctly refers to spatial and temporal implications. He writes: "The thing things world. Each thing stays the fourfold into a happening of the simple onehood of the world" Heidegger, "The Thing," 178.
77. Grosz describes things as "the point of intersection of space and time, the locus of temporal narrowing and spatial localisation that constitutes specificity or singularity." Grosz, *Architecture from the Outside*, 168-170.
78. Heidegger, "The Thing," 175
79. Heidegger, *Being and Time*, 128.

Fig 31. *Reflected.*

In the strict sense of the German word *bedingt*, we are be-thinged, the conditioned ones.

Martin Heidegger[83]

Be-thinged

I am caught as an object within an object. *Gaze Returner* very suddenly asserts himself over me – there is a moment when I see my own face as I look at a thing I can't place. What I thought was a passive object becomes active, and I can see that I have acted differently toward it than I would have, had I known it saw me too.

The camera can only catch "the deadness of the eyes that confront the machine"[84], it cannot return our gaze as a true other, the other through which we need to pass to know ourselves. The eye that puzzles over the screen is overstimulated and numb, receiving impulse but not understanding. It is this 'dead gaze' that the *Gaze Returner* reflects and returns in the moment of showing my face. At that point I look at myself, looking at myself as an object.

if the situation is unforced – to have access to what a thing is, we need to let it be as it is; arising from its own process of thinging, in which we are always implicated.[80]

Drawing the screen near

Considering the screen in these terms is not straightforward: what of the screen is a 'thing' in this way? And, is this the same enitity that is drawn near to reveal human concern? Chapter one identified a series of screenic relata – the object, the image, material and effect – which of these entities reveals human directedness?

Heidegger explicitly excludes technology, and particularly the television, from thinging.[81] For Heidegger, the television is an instrument of transposition – it does not allow things to arise from within their contexts. In this sense, televisual things cannot be drawn near, and cannot be found within the context of human concern – rather, they are transposed by the device. In other words, the television has its own directedness, its own mode of production. The television generates materiality and agency: it is a production that produces, a second order production. The television viewer, no longer involved in situating themselves throught drawing things near in concern, becomes passive alongside the actively situating television.

Images produced by the television may be close, but they cannot be near for two reasons: the process of drawing nearing is not entered into by the person so cannot be made within their interest, and the television cannot reveal things and spaces as differentially distant because it places the two spaces within one another.[82] The screen as a fixed material object may be drawn near, but what it produces cannot be.

80. Heidegger writes: "if we let the thing be present in its thinging from out of the worlding world, then we are thinking of the thing as thing. Taking thought in this way, we let ourselves be concerned by the thing's worlding being." Heidegger, "The Thing," 178.
81. Heidegger writes: "the peak of the abolition of every possibility of remoteness is reached by television." Heidegger, "The Thing," 163.
82. Closeness and nearness are not the same thing for Heidegger. Nearing can reveal things as close and far, so long as they are revealed as a perceptual process centred on concern in the world: "What is nearness if it fails to come about despite the reduction of the longest distances to the shortest intervals? ... What is nearness if, along with its failure to appear, remoteness also remains absent?" Heidegger, "The Thing," 163-4.
83. Heidegger, "The Thing," 178-9. Heidegger uses the term 'be-thinged' to describe the dependency of people on things.The thing is brought forth out of the world, and at the same time it reveals the world to us. We rely on things in this way, to reveal our directedness toward the world to us.
84. Susan Buck-Morss uses this phrase in describing the Benjamin's 'anaesthetic'. Susan Buck-Morss, "Aesthetics and Anaesthetics: Walter Benjamin's Artwork Essay Reconsidered," *October* 62 (Autumn, 1992): 18.

Grosz too notes technologies as "the production of things that produce things," but this poses less of a problem to her analysis. Grosz's focus on the thing as a "provocation to action and … itself the result of our action" allows technology to stay within the realm of the thing, as it "increasingly facilitates ... Wider possibilities of acting, more action."[85]

The thing and the human

Heidegger relies on the thing as 'real', as it stands for the sum of references and intents that brought it about. Technologies like the television conceal the 'real' by predetermining these references and intents in their modes of production – by expressing their material directedness and efficacy. But for Grosz, the thing is a "carving out the real" – a process in which the real is conceptualised as a indeterminable flux of relations – to produce things: stable, divided and divisible entities that reflect intent. Grosz defines the thing as "a compromise between the world as it is in its teeming and indeterminable multiplicity… and the world as we would like it to be: open, amenable to intention and purpose, flexible, pliable, manipulable, passive."[86] For Grosz, technologies *are* things because they are more than their prescribed functions and modes of production – they are open to slippages and repurposing.

This discussion has implications for how the relations that generate the screen can be accessed. Technology may restrict or define references and intents as Heidegger suggests, but bodies do too. The difference between human directedness and the material directedness of the screen arises from a generative material agency. If the screen "finds itself already implicated in the ongoing activity," [87] it does so in the sense that it arises across a difference of material directedness and efficacy.

Grosz's analysis explicitly recognises that this difference belongs as much to the thing as to the person. In this sense, her assessment of the thing is well placed to provoke the relational plane of the screen. Her recognition of the role of the thing occurs because she is less focused on what technologies are for, and more concerned with how they can be experienced. She wishes to "orient technology not so much to knowing and mediating as to experience and the rich indeterminacy of duration," writing that this might be achieved through developing "an acquaintance with things through intuition" rather than intellect – by taking note of the "untapped, nonpractical, nonuseful"[88] nature of things.

85. Grosz, *Architecture from the Outside*, 176; 169; 177.
86. Grosz, *Architecture from the Outside*, 170; 171.
87. Lucas D. Introna and Fernando M. Ilharco, "On the Meaning of Screens: Towards a Phenomenological Account of *Screenness*," *Human Studies* 29 (2006): 63.
88. Grosz, *Architecture from the Outside*, 183.

Not for: outside the screen

Given this mechanism of finding relata from relations, the role of the screen's use in its ontology becomes clearer. In looking at materiality and agency as relations, 'use' is presented as only one possible relation among emerging materialities. The focus in relational analysis is not on materiality and agency in terms of what I can do with the screen, but on materiality and agency as processes that exist before myself and the screen and give rise to each of us together. Use is only one of a myriad of possible agencies and materialities that can arise from these relations. Focusing solely on the use-context of an object sets a directionality to our analysis that needs to be avoided. This last section will frame the role of the use-less in provoking screenic relations, and the particular types of reactions that emerge from this provocation.

There is a fundamental contradiction here: calling a thing a 'screen' already implies its use in the world to which it refers. That is, things are called screens because they behaves in a screen-like way, they have screen-like material and screen-like effects. The use of a thing and its naming and ontology are closely tied through perception. Grosz quotes Bergson on the ontology of things in regard to use, saying that "our perception outlines, so to speak, the form of their nucleus; it terminates them at a point where our possible action upon them ceases, where, consequently, they cease to interest our needs."[89] When a name is used to identify a thing, what it is and what it does have already been presupposed. This reflexive determination relies on human intent, human concern toward the world, and the material intents of the thing.

Use and material

The use context is essential in determining the screen as screen, but it does not allow access to the relations that brought it to surface as such. Nor does it seem to allow access to the screen in itself because, as a mode of production, the efficacy and material of the screen are determined to lie in what it produces – the 'other' side of the screen. Use will not give access to ontological relations of the screen because it enforces a determined and active subjectivity, just as it enforces a passive objectivity.

Screens with a strong sense of use make defined relata. The lattice, for example, is easier to understand as an object than the television because its use as a barrier is perceptually supported by its materiality. By contrast, viewing televisual images contradicts the perception of the television's materiality, despite these images are clearly a product of this materiality. Even with the lattice, however, there remains an excess to this relation of use. The lattice, as a screen, has screen-like behaviours tied directly to its reflexive materiality. The relation that brings about this materiality brings about a bodily condition of containment at the same time.

89. Grosz, *Architecture from the Outside*, 174.

The impermeability of the screen surfaces at the same time as the inability of the body to permeate it. The determination of the screen as being 'for' containment is simply resolved within the materiality of the object itself. But the excesses of this relation become far more obvious with televisions and smartphones.[90] A simple way to think of this excess is the ability to turn the screen off. The ability to turn a screen off lends a person control over removing the screen's mode of production, and thereby its use. Such control accentuates this use on the one hand and leaves the screen less open to non-useful or unexpected engagements. When the television is switched off, its use is removed from the material relation and an excess is revealed. The thing is still there, but it is unable to be watched. It is now something that has to be worked *with* or worked *around* rather than worked *through*.

The excess of the relation between the 'inert' material of the screen and its use can be seen even while the screen is on. Jim Campbell's *Home Movies* (2006-8) achieves such an effect by obscuring the mode of production of the screen so as to reveal its excess. Part of a series of low resolution works, *Home Movies* uses LED strips to produce a degraded, back-projected image.[91] The work emphasises the screen as produced and producing – the 'black spots' of the LEDs hide the image behind so the image is composed only of an aura around these dead, but yet still effective, pixels. The mechanism of projection in the works deliberately obscures the fidelity of the image and draws attention to the screen as it projects, ensuring that "the apparatus adds its own degree of expressiveness, affecting the emotions of the viewer, if only by creating obstacles to receiving a single channel of denotation."[92] This awareness of the screen-as-object as it both produces and interrupts the screen-as-image puts the production into direct conflict with the product. Screen and image become conflicting things, and within this conflict a new engagement is found. The materiality of the screen thing is brought into appearance by obscuring the fidelity of the produced space, making clear the material process by which the screen is formed.

With, not through

If the 'for' and the 'thing' are implied in one another, ideas of 'screen-ness' are predetermined: without a use or intent, the screen will not be revealed as such. However, use is not the only context in which things appear in the world. Use-less things are also encountered in the world – things that are not approached primarily according to their

90. Paul Frosh writes that it is the material of the television, the box that 'contains', which supplies its uncanny effect: "It is this idea of a backstage location behind the screen whence the pictures come that supplies some of the uncanny effects of television as a separate, horrifying world that is more than merely virtual." Paul Frosh, "The Face of Television," *The Annals of the American Academy of Political and Social Science* 625, no.1 (Sep. 2009): 96.

91. Jim Campbell, "Portfolio: Low Resolutions Works," accessed August 28 2017, http://www.jimcampbell.tv/portfolio/low_resolution_works/.

92. Richard Shiff, "Look to See by Looking" in *Jim Campbell: Material Light*, ed. Steve Dietz (Ostfildern: Hatje Cantz, 2010), 73.

Can it hear itself?

The ATMega328 is a small processor with limited space, but image processing is memory intensive. *Gaze Returner* had some trouble trying to receive and display images. Images are commonly stored as JPEGs, a file format which uses a lossy compression to generalise and compile pixel data into a smaller file. This file is then unpacked at the display end into an uncompressed pixel array which is 'pushed' to the screen pixels as a location and a value. *Gaze Returner* doesn't have enough processing power to compress and decompress images on board. He also lacks the memory to hold an uncompressed image; making image processing a difficult task.

Gaze Returner has an Arducam OV2640 interfaced with an Adafruit 1.8" TFT display breakout with SD card reader, both of which have independent pixel-addressable buffers to store a bitmap. Problems in the interfacing of these components result in mistranslations, and distinct changes in his spatial interpretation.

The first of these mistranlations had to do with voltage. Although the ArduCam and display can both run at 3.3V or 5V, they can only run at the higher voltage by means of a voltage shifter integrated into their breakout boards. The SD card on the TFT breakout, however, is integrated before the voltage shifter. Writing from the ArduCam's buffer at 5V to the SD card at 3.3V is like shouting very quickly at the SD card. This meant that *Gaze Returner* could hear the quiet, dark pixels; but the loud pixels showed up as waves of grainy colour.

The second mistranslation had to do with the amount of information used to record the pixel. A bitmap codes the location and colour value of each pixel using a particular number of bits. The ArduCam records at RGB565 – 5 bits for red, 6 for green (split across the byte boundary) and 5 for blue, resulting in 2 bytes of information. The TFT displays at RGB888, which requires 3 bytes of information. The data received from the ArduCam had to be bit-shifted and padded out to be readable by the display. Although this bitshifting should work in a predictable way, they produced a duotone bias in *Gaze Returner*'s sight, with purple or green glows in saturated or unsaturated areas. Every change to this translation – inverting high and low byte read

use value.[93] This may explain why alterity interrupted the context of screening in the previous chapter: in expressing its role in the relation of use, what the screen began to express was its own mode of production, the sense in which it was active prior to its interaction with the subject. This activity lent the screen a sense of subjectivity or sociality along with it – a relation that lay in excess of the use to which it can be put. In claiming its own mode of production, the screen has to be worked with: it declares what of it lies in excess of human intent even as it directs itself toward this intent. Rather than the thing becoming invisible in its use, or divorced from this use context entirely, the screen expressed what it does. The material efficacies of the thing are made clear and need to be negotiated with it.

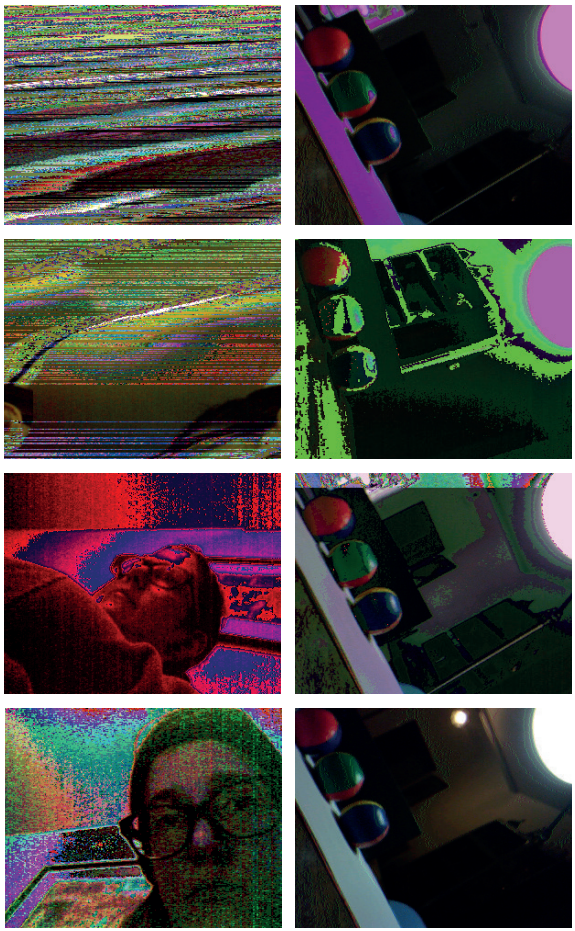

Figure 32: *Shouting*.
A series of images taken during writing from ArduCam to SD card.

Figure 33: *Spatial Translation*.
A series of images taken during testing bit shifting and write orders in translating RGB565 to RGB888.

93. Heidegger differentiates particularly here between the relation that people take towards others and the relations they take to things. Rather than being approached in concern (in which use and intentionality play a large part), people approach other people with an attitude of solicitude (characterised as being-with-others and expressing self). Heidegger, *Being and Time*, 157. Heidegger also find the 'useless' within our "concernful dealings" – when tools are damaged, missing or "stand in the way of our concern." These things retain their connections to their contexts, but cannot be put to use. Heidegger, *Being and Time*, 102-3.

order, inverting most and least significant bit order, trialling different RGB write orders, altering shift values – changes the way *Gaze Returner* sees.

The ways that *Gaze Returner* was seeing, however, were not the way that I was seeing. To find a more human representation in *Gaze Returner*'s spatial interpretation, I had to communicate with him as he communicated with himself, understanding the ways in which open and closed gates were organised into information across different structures. Finding a common ground between *Gaze Returner*'s seeing and my own was a negotiation across this language. The complexity of these translations revealed *Gaze Returner* as something complex, as a collection of more individual things that needed to communicate amongst themselves. In any image, a difference between the space that was represented and my own way of seeing of space could be the result of any number of factors – of the speed and volume with which the components talked, of the order in which they read, the order in which they wrote, of the pieces of information they understood as meaningful or unmeaningful. Unless all of these factors were consistent, *Gaze Returner*'s bits acted independently of the others, resulting in non-human spatial perceptions.

Screen things that express the 'for' relation for themselves also stress the indeterminate, the relations that escape use. These act as a provocation to the use context and arise as an thing-bound agency: as capacities for action that are not bound to subjectivity. For a person to find intent within this pre-expressed capacity for action, they need to acknowledge the thing's role in the relation of agency. As Sean Bowden states, a person finds intent by identifying within an event "the content of one's intention – the meaning and purpose of one's action – in its nonisolatability from a shared expressive medium."[94]

Structures such as intent and use, according to the assumptions of a relation-based analysis, allow the constant tide of relations in flux to become fixed, resulting in stable things and stable selves. When the 'for' is not resolved as expected from familiar relata, a disconnect occurs between human intentionality and the material intentions of the thing. Events are surprising.[95] Materiality becomes less a matter of material properties and more a matter of material directedness – a materiality that works apart from use and apart from subjective intent. This in turn makes clear the differences between my material directedness and 'intent' as an act of will. By expressing their material directedness outside of their use, things appear disinterested in people. That is not to say that things stand against people, but rather alongside them. Their actions and material are revealed as not-quite-for humans, and in this way the human's relation to their context – and, along with this, their ability to easily determine relata – is interrupted. Things become for-themselves, rather than for use.

94. Sean Bowden, "Human and Nonhuman Agency in Deleuze" in *Deleuze and the Non/Human* ed. Jon Roffe and Hannah Stark. (London: Palgrave Macmillan, 2015), 76.

95. Bennett uses Latour's phrase the "slight surprise of action" to refer to "an effectivity proper to the action itself, arising only in the doing and thus in principle independent of any aim, tendency, or characteristic of the actants" Bennett, *Vibrant Matter*, 27.

> The computer system, with its keyboard, display screen, pointing device ... and selection buttons ... affords pointing, touching, looking, and clicking on every pixel of the display screen. Most of this affordance is of no value.
>
> *Don Norman*[96]

Intent and intent

My design intent with *Gaze Returner* had in mind a different kind of thing. The intention I lent to *Gaze Returner* was to take and record a picture, which would allow him to show pictures of a variety of people with whom he had interacted. After interaction with me, my picture would be shown to others, I would be surveilled and shared as an object among other subjects. *Gaze Returner*'s intent developed differently.

An image is a large file. Even at 320 x 240 pixels (the resolution of the ArduCam's sensor), an image takes 150kB of storage space. The image can't be stored on-chip – remebering the scene meant transcribing the image to an external SD card pixel-by-pixel as a string of data, a process that takes twelve seconds. This resulted in a twelve second silence between *Gaze Returner*'s warning and his retaliation. Twelve seconds of unreciprocated interaction misaligned *Gaze Returner*'s interest from human interest. His material directedness, the things he can do quickly or slowly, gave me long enough to assume a completion, to lose interest and to leave. To maintain an effective interaction, *Gaze Returner* instead loads the image directly from the ArduCam buffer to the screen. The load takes 1.5 seconds to complete, a slow reveal of the self. The slow intentionality of this image load shows me as I am being constructed by *Gaze Returner*.

Gaze Returner's components – his processor, his camera, and his LCD – have their particular material restrictions that reveal particular effects in interaction. I had intentions for him, but he had his own.

of agency, in expressing its own relations to the world, or by acting between the person and their world.

United Visual Artist's *Triptych* (Paris, 2007) expresses just this kind of relation. Standing within urban space, three large LED blocks project a soft blue light and soothing sound. Coupled to motion sensors, the blocks respond to the approach of people, emitting harsher sounds and an intense red as interactants move closer and closer. The effect is a suggestion that the piece "has a temperamental and powerful presence within,"[97] that it expresses a specifically subjective form of agency.

Pieces such as *Triptych* lend themselves an almost animistic quality – their activity seems lively and intentful. The term 'animistic', however, is inconsistent with a relation-based analysis. 'Animism' and 'anthropomorphism' already assume the location of agency within the human subject and its ability to grant this agency to the nonhuman. Within a relata-based analysis, this must be a flawed position – agency is a subject-bound quality. Such a position is seen as naïve in that it disavows the role of human intent. Within a relation-based analysis, animism is not the subject's granting of agency to something that is incapable of holding it, but the recognition of generative aspects of agency that occur before the subject and object. Animism acknowledges that

An animist's attitude

Discussing things as self-expressive, acknowledging, and disinterested lends an agency to things that is perhaps beyond conceptions of material efficacy. To consider the screen as 'disinterested' implies that it could have an interest in the first place – that it could be involved in its context. The screen—thing becomes an 'other' through strong expressions of its material agency; and within this expression, finds a different kind

96. Don Norman, "Affordances and Design," accessed August 10, 2017, http://www.jnd.org/dn.mss/affordances_and.html.
97. United Visual Artists, "Triptych," accessed 30 August 2017, https://uva.co.uk/works/triptych.

A personal pronoun

Is it a he?

I didn't name *Moubie*. He was named by another, as a baby mouse. He was designated *he* by another. The active object is a difficult thing to express in a personal pronoun. Can *Moubie* be lively as an *it*? Does the term lend itself to animism? Perhaps, as in a mouse you were about to trap, as in "it's running across the floor, quick, get it!," there is a recognition of liveliness in *it*. But it is the recognition of a liveliness that can be put to your own ends – a liveliness that can be manipulated, used, squished.

the role and capabilities of an object are the result of underlying relations that generate subjectivity along with objectivity. Bennett comments on the effectiveness of such a technique, saying that anthropomorphisation can shift understandings by "revealing similarities across categorical divides."[98]

Animism can act as a denial of the static material and, more widely, of fixed relata. Invoking animism can affirm the efficacy of the screen outside of the relation of use, and thereby the efficacy with which the relations behind the screen are being provoked. McCarthy recognises this possibility in "wondering why people often decorate TV sets ... why they cover them with cloths as if televisions are precious icons."[99] Design historian Kathryn Smith also notes televisual agencies in mid-century concerns that the TV was replacing the fireplace as the focal point of the home.[100] Rituals of use carry similar possibilities, from Amir Ameri's discussion of separating the space of cinema from its surrounds in the early twentieth century, to concerns about compulsive smartphone use in the early twenty-first century.[101] These actions of homage and fear signify a strongly effectual relation that borders on liveliness.

A broken screen

Animism surfaces as the thing reveals its recalcitrance, as it fails to act for the human and begins to act alongside the human – for itself. Another specific relational reaction occurs in brokenness. In breaking, as in animism, the 'for' of screen, the screen as available for use, is interrupted by the 'not-for' to the extent that the use context breaks down. The screen thing, in refusing to be a screen, becomes conspicuous, obtrusive, or obstinant.[102] This obtrusiveness reveals a thing that is not working as expected – as this obstinant object is found, so too is what it was that was expected.

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98. Bennett writes: "a touch of anthropomorphism, then, can catalyze a sensibility that finds a world filled not with ontologically distinct categories of beings (subjects and objects) but with variously composed materialities that form confederations. In revealing similarities across categorical divides and lighting up structural parallels between material forms in 'nature' and those in 'culture', anthropomorphism can reveal isomorphisms." Bennett, *Vibrant Matter*, 19.
99. Anna McCarthy, "From Screen to Site: Television's Material Culture, and Its Place," *October* 98 (Fall 2001): 97.
100. Smith refers to the annual report of the Coal Utilisation Council for 1955 to demonstrate this point, where she suggests that the headline "Television Versus the Fireplace" conveys concern and alarm over the role of the television in the home. Kathryn M. Smith, "Domesticating Television: Changing Attitudes in Postwar Britain" in *Interiors* 3, no. 1–2 (2012): 30.
101. Ameri remarks that film and 'reality' have been "conceptually, and for that matter, spatially and architecturally kept apart" throughout cinema's history. Amir Ameri, "Imaginary Placements: The Other Space of Cinema" in *Journal of Aesthetics & Art Criticism* 69, no.1 (Winter 2011): 81.
102. Heidegger writes conspicuousness, obtrusiveness, and obstinancy as three ways that the "ready-to-hand loses its readiness-to-hand in a certain way… It does not vanish simply… in the conspicuousness of the unusable. Readiness-to-hand still shows itself, and it is precisely here that the worldly character of the ready-to-hand shows itself too." Heidegger, *Being and Time,* 104.

Making broken things

What does it mean to make something broken? There is a moment where *Gaze Returner* is silent, after he has warned me, when I step just a little closer. This is a stressful moment – I'm not sure what he is doing, or why he has suddenly stopped interacting. I think he might be broken. I move around to change my line of sight to the silent screen, maybe I just can't see it properly anymore, or maybe I have to re-manoeuvre myself so that I can continue to interact. There's no response. As I'm about to walk away, he shows me to myself, and I see that he was planning this all along.

An internal competition

Is it possible to reveal a material agency in the screen? Can we see the screen as agential and material at the same time? There is a kind of competition between the screen as a material thing and the screen as an effector. The otherness of *Moubie* and *Gaze Returner* renders them less screenic. It draws away from the use-context and towards something else, something lively and not of objects. The silent materiality of the thing is interrupted by its expressions of itself, toward space and toward others.

The contexts of the 'for' and the 'not for' might reveal the screen as an internally competitive whole, as a point of agential and material tension. Does the screen surface as a recognition of such a competition between materiality and agency? Or does this tension belong again to the form of analysis, to the way that relata are drawn out of relations?

Obtrusiveness may be seen as a material fault, as the screen no longer being fit for purpose, such as when a phone becomes immersed in water, or 'dead spots' appear on an LCD. Such faults open up the relations between people and things and how things are relied on. Or obtrusiveness might reveal how things such as the phone can be incorporated into the body, or how its material interacts with the environment differently to our own. It might draw attention to the composition of a space which is approached as whole and immersive, as being constituted of individual pixels, each prone to failure independently of the others.

Breaking works to reveal an inconsistency between what is assumed and what is presented. As it does so, it also reveals the assumptions themselves –insight is gained into the world before relata. As Hayles comments, we can never find *what* things are, only whether the way we have modelled them is consistent or inconsistent with the way things are.[103] In the cases above, the broken screen reveals something of the screen itself and of our involvement with it. The broken screen, like the animised screen, allows us to see what was expected in how these expectations have not been met. In so doing, the onus of interaction between person and screen is shifted. The screen—thing is no longer a thing for use, directed towards the world in the same way as me, but something that must be negotiated with.

103. Hayles writes: "The best we can do is determine if our models are consistent with the unmediated flux as we experience it… in determining this consistency or lack of it, constraints play a special role. Inexpressible in themselves, they cannot speak the truth; they cannot say 'Yes, this is how reality is.' But they can work to allow us to see that certain modes are not consistent with the unmediated flux; they can say 'No, this is not how reality is.'" Hayles, "Desiring Agency," 145.

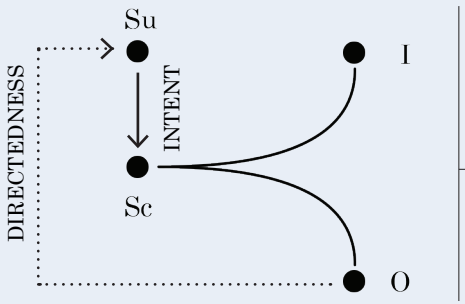

Fig 34. *Intent and Directedness*.

ORDERING AND THE ONUS OF INTERACTION: ONTOLOGY AND THE SCREEN-AS-RELATION

The agential and material relations that reveal the screen have a peculiar volatility that leads to a resistance to being situated. The screen *per se* is difficult to attribute agency and materiality to as these qualities seem against the screen, leading to the prioritisation of the image or the frame. But the screen does have a specific material agency – firstly as a mode of production, and secondly as the excess of this mode of production. The television, for instance, occupies a particular material agency in the way it produces space. But it also has a material agency when switched off. This second state of the screen is an uncanny one, in that it makes clear that the actions of the screen, now absent, are more than its mode of production. It becomes difficult to resolve a use for this screen—switched—off, at which point it becomes difficult to call it a screen at all.

This chapter focused on the excess of screenic determinations in order to reveal something of the plane of relations that generates the screen. This revealed a strong contradiction between the screen's material and its use, one that was generated by a force of materiality.

The screen was found to have a strained relation to its own use. The screen was not found within a tool relation as something to be directly and intentfully used to produce things. Rather, it was found to be a mode of production in itself.

The screen produces material relations. In this sense, materiality is ontologically fundamental to revealing the screen, even if a stable, reflexive material is not. In other words, the screen presents materially in an indeterminate and unresolved way, leaving materiality accessible as a relational possibility. The screen is, in this sense, materially active: it acts materially to bring things about. More than simply presenting materially, the screen *produces materiality* – the screen is itself a process of materialisation, it orders space in a particular way so as to express material relations.

The recognition of the screen *as* a screen lies in the way it generates material. Because the screen acts materially to produce space, it acts as a form of spatial ordering. On the one hand, this spatial ordering is for humans. This is, after all, how the screen is useful for us. But the ordering that the screen undertakes is not a human ordering, rather it is something that happens alongside the human. In finding a 'screen' within the world, a person is finding a difference in the way that space is ordered. The way that this ordering takes place is different from screen to screen because it depends on a material directedness.

The screen's production of materiality is, of course, contingent on the material of the screen itself. The composition of the screen is itself ordered in a particular way. The LCD is ordered as an array of pixels, but each of these pixels is also dependent on an ordered array of information. The screen's ordering of space is produced not only by the ordering of its pixels (or apertures) and the relations between them, but also by the ordering of the information that reaches them. The screen orders space in a particular way, at certain paces and a variety of scales that are directly related to its material composition. This material directedness produces spaces differently to human space. Distance, orientation, and other forms of human spatiality concern the material directedness of the body. This new ordering is found alongside the human, in the material directedness of the screen.

The body, then, has to be found on both sides of the screen: the reflexive body that interacts with the screen thing, that is available to order the object of the screen as it sits in space; and *another* body, one that is still caught within the generative material relations to the other side, that is being ordered by the screen. The activeness of the other side allows the embodied split to be resolved with a negation of the screen—as—object. The body is then found amongst the generative relations of the 'other' side. If the screen's material becomes too obviously active, however, this screening relation is challenged: the generative body is pulled from the other side to this side, where it interacts with a material thing, no longer a screen. The 'screen' as relata is abandoned in this state, the thing needs to become something else – a piece of furniture, a window hung on the wall, an icon; or else something hidden within a cabinet or behind a curtain.

The ways in which the screen produces material disconnects its own, object—like material from its use. In some ways, producing material is what the screen is *for*, but the sense of activity with which the screen produces means this relation cannot reveal the screen as a tool – the screen's own, reflexive material counteracts its use context whilst at the same time producing it. The same force of materiality that is responsible for recognising the screen acts on the material of the screen itself, which cannot surface.

The screen remains materially active, but cannot declare itself as such. If this material efficacy is pushed further into a more obvious expression of agency – an agency that shows reciprocation and a sense of directedness as well as an efficacy – the screen disappears and becomes something else.

Directedness and reciprocation are the very basis by which the screen can be recognised, but the screen relies on them remaining implicit. We ask for a passiveness from the screen's material for this reason. When the screen's use context becomes difficult to resolve, or its

material too active, other relations become more clearly accessible. Broken things, things that are express their roles or interact with their environments disturb the revealing of the 'screen'. Different perceptual attitudes are used towards these things. Animism, breaking and other expressions of agency shift the onus of interaction, counteracting the passiveness of the screen.

In this condition, the screen is no longer something that is fit for purpose – something that can be worked *through*. Instead, it becomes something with which a new relation must be found, a new materiality negotiated. This reflexive shift between subject and object, from *for* to *with*, also reveals something of the generative relations from which the thing emerged. In not being what was expected, it becomes clear what was expected.

ASSUMPTIONS AND CONCLUSIONS

Considering the screen as surfacing from a plane of relations leads to the finding that materiality and agency – considered as separate mechanisms at the conclusion of the last chapter – are actually not so separate. Rather, they show up in a kind of competition in revealing the screen, each dependent on but opposed to the other. That is, although these relations arise from the same plane, the ways that they are resolved into relata mean that one or the other tends to be ignored. The screen occupies a particular point of tension between and within agency and materiality. The materiality and agency of the screen contradict one another. The screen can be materialso long as it isn't effectual. Converesly, the screen can have an agential effect, but this effect needs to be held apart from its material. The alterity that interrupted the screen coming about, in this chapter and the last, did so in terms of expressing a form of agency. The material object, as relatum, cannot be properly resolved whilst it is expressing its own directedness. Agency, in this sense, seems to be in an internal competition with materiality.

This chapter introduced another dimension to the figure of the analysis. Rather than focusing on a line between relata, it introduced a plane of relations. But this plane was 'resolved'. By noting a tension in agency and material, these became connected antagonists – materiality on the x axis of the plane and agency on the y axis. The screen emerges from this plane as a point of tension. This approach does not achieve the effect of describing, or even encountering, the relations of the screen; rather it has just transcribed larger relata. The difference between this set of relata and the last is a matter of scale.

This chapter has discussed a process by which the screen comes about – a process that fixes relata at the same time as remaining generative. This processual approach extended into creative practice, which began to look at how things came about as well as what they are. The further that this relation-based analysis has proceeded, the more it has become apparent that very little can be said absolutely about these relations. Written language, which served well enough in the previous chapter, does not work so well when discussing what lies behind determinations and before the reflexive. In other words, it is very difficult to say what the screen *is* when the screen is viewed within a constant state of becoming. At any point within these generative relations, language serves to freeze what is experienced, it pulls the screen out of the relation as a distinct relata.

For this reason, relations can only be discussed using iterations of language and nested of relata. In this way, this chapter has talked about material that is generated by

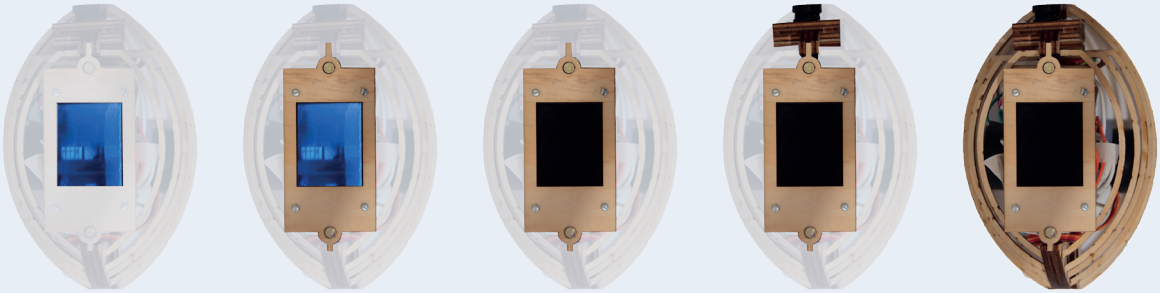

Fig 35: *Screen?*

What's in a name?

Are these screens? I can say, at least, that they *have* screens, that they are screen-bearing things. *Moubie* and *Gaze Returner* each use a screen in their interactions with me. But they use this screen are differently. The screens, then, must be different – they respond differently to me and to the space around them, they screen space differently. But the screens are the same, both 1.8" Adafruit TFT LCD displays.

What gets included in the term 'screen'? The term might, in *Moubie*'s case, include the camera which takes the image that the LCD displays, as this is what communicates *Moubie*'s relation to space. But he can only have this relation because of his wheels and motor – these are what allow the spatial relation to be produced so it can be communicated as an image. *Moubie*, though, as a whole, is *not* a screen. What does it mean when *Moubie* surfaces as an agential other rather than a material object, or vice versa?

Boundaries are drawn differently around the material and the effectual in different situations. McLuhan might say that the medium is the message, that the 'television' is not an image but a system of people and cameras and politics and space and time. Where are the boundaries of the screen drawn? What's in a name?

materiality, which then goes on to enter new material relations (out of which, of course, new material is formed). Certain terms within the language, such as "material directedness," were used as a way of looking just prior to what was being discussed. The material directedness of the screen before it becomes a screen might refer to what pixels are and how they work. But the material directedness of pixels might refer to voltage fluctuations and logic gates. In using these techniques, it has become clear that the language of relations is always contingent on a scale, on drawing a boundary around a thing and referring to what came before that boundary.

When boundaries are drawn around the screen—thing in perception, they seem to be drawn in a way that maintains this balance. The way screens are described according to what they are and do varies significantly across the range of things called 'screens'. The screen might be an array of pixels, or a repetition of apertures. It might be something that involves an external processor to map a point-cloud of data to a surface. It might be something that relies on electromagnetic waves and signal towers, or on chemical deposits and projected light. The boundaries of the screen are both larger and smaller than a single surface.

To maintain the screen as a point of tension in generative materiality and agency, the screen becomes a composite of the smaller and larger things that occupy this point. The next section will explore the idea of the screen as an assemblage of ordering. It will pay particular attention to the ways that the boundaries around the screen are drawn and redrawn. In other words, it will assume an inseparable and constantly evolving structure between relations and relata.

CHAPTER THREE

TWISTING A FIELD

Relational structure and the ontology of the screen

STRUCTURE OF RELATIONALITY

The previous chapter focused on the relations that generated screen relata and revealed the screen as a point of tension and balance in materiality and agency. Following from chapter one, a sense of use remained quite essential in revealing the screen, but could not account for what the screen is. The screen did not disappear into its use like a tool, as its materiality seems to work against its use: once the screen's materiality became apparent, the screen was no longer useful. The screen does have a sense of activity, though, in that it acts materially to bring things about. The screen arises in perception as the recognition of an ordering of space that is outside of the human. This ordering is dependent on the material directedness of the screen – on how it produces space through its own material properties. The material directedness of the screen produces this ordering, at certain paces and certain scales that are directly related to its material composition.

Chapter two concluded in recognising that the material directedness of the screen resulted in a form of spatial ordering that sat alongside human spatiality. If this material directedness is expressed by the screen, however, it does not surface in perception as a screen. The screen relies on its material directedness remaining implicit. In altering the balance between agency and materiality, 'screens' were not produced. Rather it was a screen-bearing object, or a quasi-subject that arose in perception. These things worked alongside the human, acting at paces and scales that interfered with human spatial ordering. In response to deforming this point of tension, the screen became available as a composite of the smaller and larger things that occupy this point of relations. These things might include apertures, pixels, light, casings, framings, objects, and political meanings – all of which are ordered in their own way. But describing the screen in this way does not allow us to encounter the relations of the screen, it only transcribes smaller and larger relata with which we can interact.

Some Assembly

Some Assembly is not a screen, though it is screenic. It crosses over critical thresholds in the experience of a screen so as to help reveal what this experience is. *Some Assembly* has a group of sixteen identically composed and programmed, self-contained 'bots' that inhabit a television.[1] They sit and roll over a moving image similar to a test pattern, an environment spatialised in colour. The bots have responses, four different ways of situating themselves in this environment. Each of these has a speed, an order, a density; each is connected to the ontological condition of the screen.

The bots are made in the same way. They each have wheels, and servo motors to control them. They have ultrasonic distance sensors – eyes – and a servo motor to turn them. They have a colour sensor, and an RGB programmable LED to see and display colour; an RF transmitter and receiver to communicate with. And, of course, they have the same behaviours. But they're all a bit different.

Well, not so different, at first. They start out in a structured grid, an ordered array of bot-pixels, doing a simple colour read and display. The stationary bot translates the changing environment of the image, taking the colour and displaying it on his back. The bot's display outlives the initial trigger, so that the grid of colour below is transferred to a grid of colour above. But the bots don't stop here, they begin to look around, to find the edges of their environments. Sixteen small bot-pixels looking around – in-time, but out of step. They're not such an ordered pixel array now. They're still acting en masse, they read and display colour at the same time. But they're doing something else too, something seemingly for their own purposes. They've got two states: a 'display', a production of the image, and a 'looking', an agency of their own.

One of the bots falls out of line with the others and the grid is broken. This little bot, rotated in spot, out on his own – probably an uneven power distribution to a servo motor. Soon after, the bots begin to 'back out' of the array. One by one, more or less, each flipping states on his own. They're not backing out evenly though, they have bias in certain directions, and move at different speeds. Bots who have seen a lot of dead patches, who 'display' black more often, are keenest to get out of the grid. Now, when they display, they are doing something new. The

colour they're displaying isn't a mimicry of the grid below them, it's interpreted between them. The screen on top of the bots, the one made by their backs, starts to explain the spatial relations between them. These two guys are side-by-side, this guy hasn't moved very far at all. They're still displaying in-sync, but it's harder now to tell the two states of movement and display apart – these states begin to rely on one another. The bots are different to one another, they move faster or slower, go to the left more or the right more, but when they display, they're cooperating. Not a mass anymore.

Then one bot turns around, does a full 360 and starts moving forward. He's looking with intent now, seeing walls and other bots and purposefully avoiding them, navigating around the environment. The others follow suit before too long. Bots begin to approach one another, face-to-face. Some lock horns and push each other around the place. Some chase others around. Some get stuck in corners or surrounded by packs of bots. They seem so pre-occupied with themselves, in fact, that they don't all hear their trigger. Some bots are still vigilant, displaying their colour on time, but others wait a while, not wanting to display just then. Others just refuse to display and keep moving about, pushing the vigilant bots off their squares. It's really hard to call this a screen, now – more like a group of bots punctuating their movements with party lights.

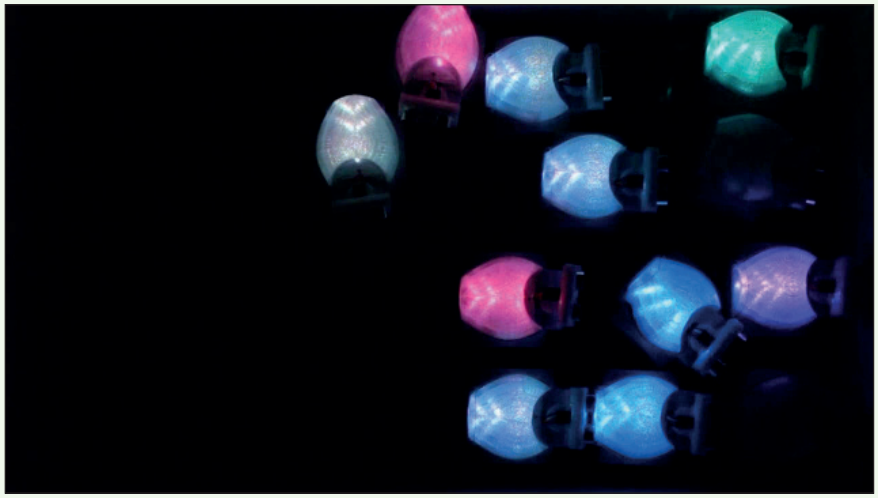

Fig 36: *Some Assembly (Short)*. [Video, 03:51].

1. See appendix G for circuit diagram and code.

This chapter will explore the scale at which the screen arises by considering it as an assemblage. It will pay particular attention to the ways that the boundaries around the screen are drawn and redrawn in perception. In other words, it will take as its assumption that relations and relata are caught within and emerge from a perceptual structure.

Chapters one and two discussed the relational framework by forming a hierarchy. Each established one of the relata and relations as prior to the other – in chapter one, the relata was considered prior, in chapter two, the relation. Each introduced a hierarchy in which its prior term was causally linked to the emergence of the second term. This chapter will attempt to flatten this hierarchy by noting the scales at which they emerge. Relata and relations are approached in this chapter as different but equivalent structures. Both the relata and relations are seen as symptomatic of a larger structure – a structure that is not about the determinate concrete thing, or the relations that connect and generate them, but about the mechanics of perception. This chapter will continue with ideas of materiality and agency, but rather than these being set up against each other, they will be shown as surfacing from within the same structure.

Materiality and agency have been addressed as both reflexive characteristics (in chapter one) and generative mechanisms (in chapter two). In chapter one, agency was linked to the subject and materiality to the object. In chapter two, the object and subject were generated from within materiality and agency as unbalanced products of these relations. Chapter two argued that the screen may arise from materiality and agency in a more balanced way, somewhere close to a midpoint between these forces as a thing that shows substantial amounts of material agency. This balance resulted in a thing that was difficult to make into either an object or subject. Attempts to qualify this point of balance by shifting it slightly resulted in an understanding of the screen that showed materiality and agency as being in competition, as antagonistic.

Material and agential emergences, however, hold much akin. Materiality and agency are both questions of substance and action – of what it is, what it can do; and what I am, what I can do. By placing emphasis on the relata, materiality and agency could only be understood as properties of a relatum, and so could not be interrogated separately from the thing. But in placing emphasis on these as processes, their separateness was too strong. That is, they were looked at from outside the screen, as processes that produce the screen and so must be separate from that which they produce. Understanding materiality and agency as part of a relational structure allows a view of the screen as a relatum on the same ontological level as the processes that produce it.

Structure of perception

> '0 and 1', that's the same as 'Yes and No' isn't it? ... As opposed to the 'bit' as the smallest data unit that computers we are using in daily life work with, the unit the quantum computer operates with is called 'qubit' (quantum bit). The qubit represents not '0 or 1', but a superposition state of '0 and 1 at the same time'... suggesting a state of things that even the best scientists cannot describe, and that no-one is able to perceive.
>
> *Ryoji Ikeda*[2]

In my daily interactions I am happy to describe the world as a subject to objects. I turn on the television, I watch a video. But this description is a contradiction. The objects of reflexive experience butt heads with the relations that bring about these objects, that bring me along with them. If relations produce objects, then these objects have to be brought back into my interaction before they have occurred. If they aren't, I don't have anything to interact with. I don't have an *I* to interact with. The television, the video have to be reflexively recognised as the pre-existing basis for the interaction.

In other words, the object arises out of our relation. But the object becomes recognised as pre-existing the engagement because I *have to have* engaged

2. Ryoji Ikeda, "Ryoji Ikeda — Supersymmetry," interview by Kazunao Abe, Yamaguchi Centre for Arts and Media, April 2014. Accessed November 13, 2017, http://special.ycam.jp/supersymmetry/en/interview/.

with it. An interaction demands things that interact – I know I was me before the interaction, surely the object was too? Is the object of before, the thing with which I interacted, the same as the object of after, the thing with which I have interacted?

Relations are in context. Every shift in context, the passage of time and space, changes the relations. Every time I interact with the world, the object and subject are both fundamentally changed. The relations that produce this television and this video are different to those of yesterday, so the television and video are different to what they might have been yesterday. The television of after is different to the television of before. So how are they the same television? What differences are allowable amongst what stays the same? What is the structure of this difference, from where I can find a television again and again?

I said before that design has a strange task in this *a-posteriori-a-priori* perceptual process – the thing I am interacting with arises out of the interaction itself, but has to be brought back in to the beginning of that interaction to form its basis in the first place, just as I do. But now the thing I design will never be what is brought out, nor what is brought back. It has already formed its own alliances and taken its own direction. The structure out of which this designed thing falls is updated to account for it, this new thing is now a possibility.

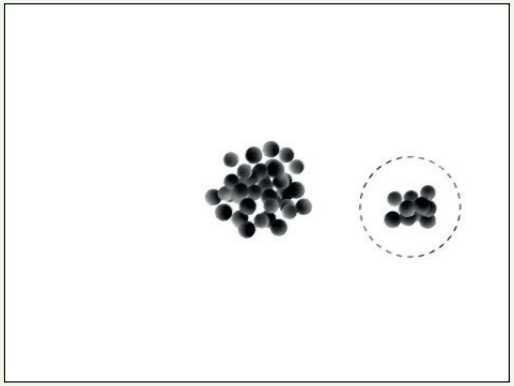

Fig 37. *Perception and Determination*. [Video, 00:35].

This chapter looks at the screen according to its structure of relationality; according to how relata and relations fall in and out of each other in perception. This non-directional structure allows relata and relations to be considered on the same ontological level. That is, there is no hierarchy

present in terms of whether relata or relations are *a priori*. The screen is addressed here as a series of relations and relata with a focus on how they become perceivable as such. To consider the relata and relations as ontologically equivalent structures requires another change in the way perception is understood to be structured. The process of 'thinging' introduced in the previous chapter will be approached in this chapter as iterative – as a matter of drawing perceptual boundaries around relations to produce relata at different times and at different scales as materialities and agencies change. The major assumption of this approach is that the relata and relations are bound within a larger structure, one which keeps them together in possibility without any individual instance necessarily being enacted. This structure is the basis of the screen, out of which relata and relations can be concurrently and contextually generated.

Chapters one and two each held the relata and relations apart, considering them as mechanisms on different scales. This resulted in distinct problems in the argument in these chapters, problems deeply embedded in the nature of their aims. The more that relata and relations were held apart in a hierarchy – one generating the other – the more impossible it became to discuss the primary term without reference to what it generated, or the secondary term without talking about what generated it. Brian John Martine comments on the inseparability of relata and relations, remarking that attempts to place one of the determinate or indeterminate aspects of experience as prior to the other are always ontologically flawed: "problems arise only when we begin to insist from some reflective vantage point that one or the other of these manners of being related must take pride of place." Both the determinate and the indeterminate are important structures of knowing, but moreover, it is their interplay that is of most importance.[3]

3. Brian John Martine, *Indeterminacy and Intelligibility* (Albany: State University of New York Press, 1992), 3-4; 18-21. Martine notes that determinacy and indeterminacy are inextricably linked. Determinacy needs indeterminacy: "It is not possible to separate the determinate dimensions ... from their necessary relation to the indeterminate dimensions of experience" Likewise, indeterminacy needs determinacy: "The indeterminate dimensions of experience are ontologically bound to sameness, limitation and determinancy. Hence it is just as dangerous to deny the place of the general principles, laws and structures that are grounded in sameness as it is to abandon ourselves to the unrestricted hegemony of the Absolute." Determinacy and indeterminacy are ontologically reciprocal.

Neither relations or relata alone could explain the contradictions that define the screen. Understanding the contradictions of the screen requires considering the screen's relata and relations together, as a relational structure. This presents a different figure to the axis and the plane. If the axis of the relata and the plane of the relations exist on the same ontological level, the structure that produces them must be able to support both of these emergences: points of definition, as well the stretched and rebounding surface of the relational; the determinate, and the indeterminate. The figure of this structure is presented in this chapter as a field of possibilities. The field is a loosely bounded region, constantly changing and held together in flux.

There are some identifiable points within this field, a cluster of relata that have been drawn out of similar fields on other occasions. However, the relations cannot be plotted in the same way. Locating relations as points in a field would be a move that bounds them – a determination of these indeterminate entities. All that can be found when looking at the relata is the distribution of points; that is, how the relata are positioned within the field. As with the figure of the plane in the previous chapter, an intervention is needed in the field to reveal the relations at the same time as the points of the relata. This intervention now needs to interfere with the distribution of relata as well as the relational plane. This intervention amounts to a twist, a provocation in the field that brings about a remapping of the points on the relational plane.

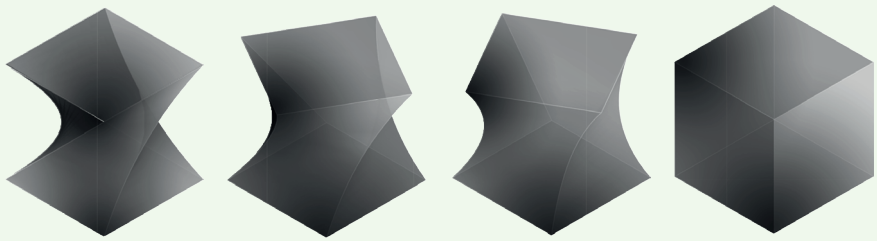

Fig 38. *Twisting a Field.*

Such a move allows the content of the field to remain intact, but remaps its structure. As this remapping takes place, different points will be stressed and others de-stressed, allowing the screen to emerge in different ways. Moreover, stressing the field in this way will reveal thresholds – critical points at which one relatum becomes another. The sense of temporality present in the figure of the relational plane is strengthened here: it is not just a matter of seeing the 'before' and 'after' of the move, but of watching the move take place. Discursively, this twist will be performed by addressing the screen as an assemblage of heterogeneous components. This cluster of components, each considered as a relatum, will be shown to differentiate from and re-join to the field of possibilities of the screen. Within this discussion, *Some Assembly* will work to twist the topology of the screen's relational field, causing a critical transition from one relatum to another and revealing something of the relational structure of the screen.

Designing to twist

> Always follow the rhizome by rupture; lengthen, prolong, and relay the line of flight; make it vary, until you have produced the most abstract and torturous of lines of *n* dimensions and broken directions. Conjugate deterritorialised flows.
>
> *Gilles Deleuze and Felix Guattari*[4]

Design is usually determinative. It takes a field of possibilities within its aim, it extracts these possibilities as ideas, tests them, actualises them in different forms. The diagrams, drawings, words, models and objects that are made are determinations of the field of possibility, they take some of what is possible and represent it in material form.

The screen is a field of its possibilities. Some of these possibilities I know: the points of the televisions I have watched in my life and the contexts they arose from, the clusters of computers I have typed in to and why and how I did so. Some of the not-possibilities I also know: *Moubie* is not a point of screenic possibility, but a form built around a screen. *Touchbuzz* and *Pitchmatcher* show me that

4. Gilles Deleuze and Felix Guattari, *A Thousand Plateaus*, trans. Brian Massumi (Minneapolis: University of Minneapolis Press, 1987), 11.

reciprocity of interaction isn't a part of the screen's possibilities, at least not on its own. The screen happens at a certain scale and in a certain way. What I don't know is where the bounds of screenic possibility are – where is the threshold of the differences that are allowed?

I can design from the points of the field I know, in which case I will get more screens, similar screens. This can tell me how screens are alike. I can design from the points of the field I know are not, in which case I will get more not-screens. This can tell me how not-screens are alike. By comparing the two, the similarities between screens and the similarities between not-screens, I might narrow in on the difference between what is a screen and what is not a screen. But the moment of transition will remain obscured. Instead, I can twist this field of relations at an accessible point. *Some Assembly* attempts this, it sits within the field of possibilities of the screen and expresses part of this field differently over time. In this way, *Some Assembly* is more of a performance than an object. At any time, the sum of its objects are either individuals or a whole. But really they are both, expressed differently in time.

Some Assembly is actualised, of course. It is a group of sixteen small, theoretically identical bots; an arena; a television; a recording device. But it is actualised in a different sort of way to a diagram or paragraph, which remains as it is for longer. My aim with *Some Assembly* is not to make a screen or a not-screen, but to make something that is at one point a screen and at another not. The twist it performs is to find itself as the possibility of two things at once, to isolate a moment of change between two things. Each bot is both itself and a part of a collective. Both of these possibilities are encased in its material, enacted differently over time.

Mostly, design creates things that are judged successful or not according to intent. The object itself has its own directedness, as does the person who uses it. The designed thing is, at the least, these three contexts together – intent, material, use… meaning. To design a twist is to account for the contexts of the thing, to allow it to change; twisting, rupturing, "cutting across a single structure."[5]

How can a thing be designed that is two things at once?

MAPPING THE SCREEN

Considering relations as primal to relata introduced a problem that a relational structure can help resolve. Specifically, considering the screen from the point of view of the primacy of relations gives rise to a problem of temporality and anticipation: if things are not permanent, but are drawn from a relational plane, how can they remain meaningful? When I say the word 'screen', what makes that word hold meaning if not its referent, the thing to which it refers? These questions relate to the continuity of the *thing* and how things are found in perception – how a thing can hold meaning and form even as this meaning and form is being developed.

One technique for addressing the continuity of the thing has already been introduced in the transcendental essence. However the essential properties that have been encountered in phenomenologies of the screen do not fit well within a non-hierarchical relational structure. The screen's 'essence' is an irreducible quality that sits outside of the thing itself, on a different ontological plane.[6] This poses a problem when considering relata and relations as part of a structure. Essential properties become fixed and permanent, existing separately (and before) the thing itself, and so are removed from any possible experience of the thing. Although the essence of the screen can tell us what of the experience of a thing remains the same, it cannot tell us how internal differences appear, or how conceptions and understandings of screens, as well as screens themselves, can change over time. The screen described by essential properties is unable to change without contradicting its definition – it becomes conceptually fixed. A conception of the screen that allows change needs instead to stay with the experience of the thing, noting its differences as well as commonalities.

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5. Deleuze and Guattari, *A Thousand Plateaus*, 9.
6. DeLanda comments that "when the properties of a given whole are taken to be brute fact, and listed as the unexplained characteristics that the whole must possess in order to be an entity of any given kind, the list of necessary properties swiftly becomes an essence. Essences belong to a different plane of being from the entities whose identities they define." Manuel DeLanda, *Assemblage Theory* (Edinburgh, Edinburgh University Press, 2016), 12.

This exploration will begin by comparing the ways that the screen holds meaning, as an individual experiential entity and a universal class of thing, to define the screen as a population of immanent screen experiences – of *these* screens. It will then move to examine the role of scale in the ways that boundaries are drawn around screen relata as assemblages, maintaining at each scale a sense of the individual. The exploration will next define the screen according to a relational structure – a field of possibility from which the relata and relations of screen experience emerge – before establishing that the screen's relational structure can be mapped and concluding with an examination of the parameters which define the screen's map.

Shifting boundaries and persistence of meaning

The screen occurs at more than one scale – it is decomposable into its constituent parts, but it is also part of a larger whole. There are two senses of the screen at issue here: *this* screen as a specific experiential instance, and its compositional materiality of pixels and apertures; and *the* 'screen' as a general class noun or concept comprising specific instances of screen experiences. In a relational structure, the term 'screen' as designating a general class is as important to the screen's ontology as any instance of the screen, as it provides a measure of what the screen is *across* its contexts.[7] As such, this section will begin by discussing the linguistic concept of the screen and changes in the meaning of the term, before establishing that these linguistic changes also correspond to material changes in screens. It will then turn away from the idea that the term 'screen' references a set of intrinsic properties, focusing instead on the term as a collection of experiential images – a population of individual screens in their contexts, which together define a screenic 'region'.

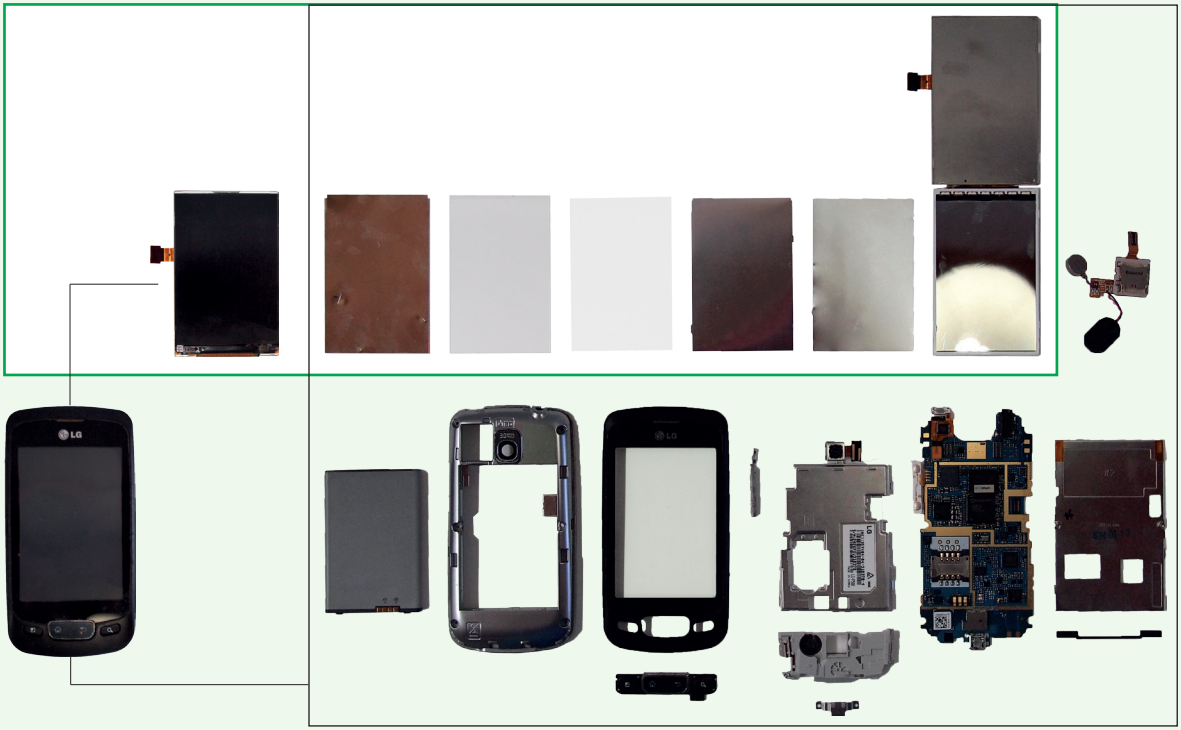

Fig 39. *Telephonic deconstruction: Layers of the screen.*

7. Brian Massumi describes these kinds of general terms as “invisible yardsticks” of experience. Brian Massumi, *Parables of the Virtual: Movement, affect, sensation* (Durham: Duke University Press, 2002), 169.

Language and material

The meaning of the term 'screen', and the referents to which it applies, have certainly changed over time. The origins of the term in Middle Dutch, Frankish and Proto-Germanic languages suggest a form of protection: as a shield (*scherm*) or partition (*skrank*); a barrier to something unwanted. Chapter one showed that 'barrier' was still a part of the meaning of 'screen' today; but also showed that the inverse, a suturing or connecting, was part of this meaning. Introna and Ilharco categorise the present-day significance of 'screen', saying that the "plurality of meanings can be brought together along three main themes: projecting/showing (e.g., TV screen), hiding/protecting (e.g., fireplace screen), and testing/selecting (e.g., screening the candidates)."[8] The diverse set of meanings of the term 'screen' are, in many ways, responsible for the problems inherent in analysing it. It is difficult to account for the similarities amongst screens, when the actions and materialities of the term are so varied.

These changes in the definitions of the term are accompanied by changes in the materiality of the screen. The term references a variety of, sometimes contradictory, material instances. Bruno acknowledges that 'screen' is a condition that can be conflated with architectural conditions such as the wall – a solid and opaque component.[9] Friedberg favours the conflation of screen and window, noting that the transparency of glass "performs a visual dematerialisation," but also that "the material barriers of glass also isolate the other senses."[10] Materialities of the screen are wide-reaching: from woven cloth or pressed paper, to a series of apertures carved from solid material, to transparent glass, to photons falling on a solid surface, to light emitting diodes in an array. The way that each of these screens appear in perception is startlingly different, yet the term used to describe them remains the same.

When the term 'screen' is used, it does not necessarily refer to any particular instance of a screen in its context. To allow generalisation, to allow the term 'screen' to have a transferrable meaning, the context of the experience needs to be generalised, if not simply ignored. As DeLanda notes, it is "only when its 'elements' are wrenched from

their singular situation does the absolute become generalizable."[11] The danger of forming generalisations by removing things from their contexts is that this linguistic act might be mistaken for an actual one: that because something can be isolated from its context in thought, it can also be isolated from its material context.[12]

Robot ontology

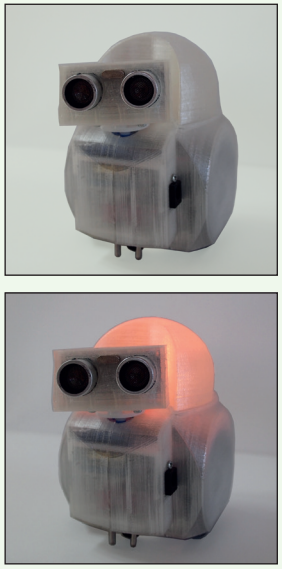

Fig 40. *Communication.*

Words can be transferred from one context to another. Ontology, in computer science, is not a coming into being or the revealing of the world. It is not philosophical. The ontology of robots doesn't ask why, but what. It is a system of naming, of carving up and compartmentalising things for a program to call upon.

The *Behaviour Boxes*, *Gaze Returner*, *Moubie*, the bots of *Some Assembly* – all of them rely on this sense of ontology. Not only is data signified in certain ways (the red channel of the display colour, for instance, is named "rd"), but certain behaviours are signified too (the sequence of activities by which colour is displayed involves pushing three bytes of data to a series of LED in order, this behaviour is called "colourdisplay"). What these things are called is inconsequential, it's just a way for the bots and I to communicate. Carving up the program like this means that colourdisplay can be triggered by different inputs, that rd can hold different values at different times, and that I can always ask what they are.

One of the bots of *Some Assembly* sees a colour. I ask, what is this colour? It analyses the colour, breaks it apart – "Well, it's mostly red, but maybe a little bit orange. It's very bright. If I had to tell you, I'd probably say rd 255, gd65, bd 0. Wait, let me show you": void colourdisplay();

8. Lucas D. Introna and Fernando M. Ilharco, "The Ontological Screening of Contemporary Life: A Phenomenological Analysis of Screens," *European Journal of Information Systems* 13, no. 3 (September 2004): 8.
9. Bruno notes that, "we must reflect on the 'superficial' relation between the form of canvas, wall, and screen…the interrelation of these forms is changing on the surface, and as distinctions collapse a form of conflation ... is taking place." Giuliana Bruno, *Surface: Matters of Aesthetics, Materiality and Media* (Chicago: University of Chicago Press, 2014), 75.
10. Anne Friedberg, *The Virtual Window: From Alberti to Microsoft* (Cambridge: MIT Press, 2006), 117.
11. Manuel DeLanda, *Philosophy and Simulation: The Emergence of Synthetic Reason* (London: Bloomsbury, 2011), 164.
12. Massumi remarks that the tendency of science and other absolute disciplines toward "reduction of the whole to the variable sum of its dissociated parts" creates a misconception where "the 'conceived separately' slips into 'conceived as existing separately'. The extracted variable is mistaken for an objective part." Massumi, *Parables of the Virtual*, 165.

If this operation of separation is performed, if continuity of meaning is looked for in what stays the same outside of context, the most reasonable conclusion to arrive at is an essence. But this thesis has shown that the continuity of the screen is not removed from the individual experiences of its materiality, and so does not exist separately from it. Screens are highly specific things, but the term 'screen' is not.

Language and properties

Instead of looking at the screen as separate from its contexts, a screen could be found that looked at individual, contextually embedded screens across their contexts. The resultant 'screen' would not be seen as a force, a "reified generality"[13] as found in, for example, Baudrillard's analysis. *The* screen could instead become an assembly of *these* screens, a kind of population of individual, contextualised instances. I'd like to demonstrate the difference between these approaches using an example put forward by William Goosens in his discussion of the 'relevant properties' of objects. A 'relevant property', for Goosens, is something that "gives us information about whether or not a term applies to objects that have the property."[14] Goosens' discussion challenges Putnam's structural realist conceptions, saying that the meaning of words is malleable because "properties associated with underlying trait terms are almost never a part of their meaning."[15] Words work, instead, by reference to experience and linguistic context.

Goosens begins by outlining Putnam's thesis that terms hold meaning in four ways: in their linguistic context, their association with more general terms, their association with properties, and their extension or material encounter.[16] He then introduces a speaker, S, with knowledge of the term 'toad' according to the first three forms: that 'toad' is a noun, that toads are a kind of animal, and that toads have specific qualities such as being warty, lethargic, awkward. Goosens then posits a disease responsible for the toads' specific qualities, and a new mutation that provides resistance, so that toads are no longer warty, lethargic and awkward. He claims that, once all the relevant properties have been counteracted, the speaker would have to treat the new animals as 'non-toads.'[17] This logical conclusion, claims Goosens, is nonsensical.

In this way, Goosens reframes the term 'toad' away from the properties common to all examples, and toward the differences between them. These differences are part of the condition of meaning: "that the properties associated with 'toad' change… is completely predictable… but this predictability is exactly a criterion of constancy in meaning."[18] If I test the term 'screen' to see if it can remain independent from its context, I find mental images of particular screens appearing, and of particular materials and objects caught within the field of the screen. Some of these are residues of my own interaction with screens – some of them are surprising, and others everyday. The term screen allows the thing to be recognisable as itself even as it changes in both materiality and function. The term, in this case, acts as a kind of placeholder for a population of experiences involving a certain thing.

The screen as a population of these screens

Merleau-Ponty discusses this changing materiality on the scale of a specific instance of a thing, rather than across a general class. In this way, he can help address the schism in scale between direct individual experiences of the screen (the phenomenological) and the continuity of meaning held by the concept of the screen (the structural). The screen, as a term that stands for a class of things which shows internal difference, includes a variety of material and relational instances that confuse its ability to be recognised as "the same throughout all possible

13. DeLanda, *Assemblage Theory*, 14. "Reified generalities" is the term DeLanda uses for things that act as conceptual placeholders; or things removed from any specific context in which they occur: "the weapon," "the tool," and, I would add, 'technology'.
14. William K. Goosens, "Underlying Trait Terms" in *Naming, Necessity and Natural Kinds*, ed. Stephen P. Schwartz (London: Cornell, 1977), 134.
15. Goosens, "Underlying Trait Terms," 145.
16. Goosens, "Underlying Trait Terms," 146.
17. Goosens states: "S may still call these animals toads because he realises that 'warty-looking skin' and 'awkward' were never logically necessary, and because the animals still have the other properties associated with 'toad'. But we could easily augment the story to argue against the other associated properties ... S would then eventually have to treat these new animals as non-toads." This conclusion, he claims, is flawed because the properties are not part of the essential meaning: "the properties associated with 'toad' change… not in spite of our conception but because of it."Goosens, "Underlying Trait Terms," 147-8.
18. Goosens, "Underlying Trait Terms," 148.

repetitions."[19] However, Merleau-Ponty shows that continuity of form needs to be established even for an individual object: things present to us as discontiguous images, and it is only together that these images make the thing.[20] Such an understanding of a specific, individual thing shows it as a composite – a collection of parts that are themselves different, but add to a sum of understandings that hold meaning as a whole. Merleau-Ponty's house seen from the street, the river, and the inside, still form the house; even though these are strikingly different perceptions. The same could be said of any individual screen, as well as the screen as a general term. A lattice, a television and a phone each contributes to an understanding of the 'screen' despite being very different things. The meaning held by the term does not sit separately from these individual instances but alongside them. Later in his analysis, Merleau-Ponty revises his definition of the house as being "seen from nowhere," preferring instead an understanding of the thing as being seen "from everywhere," from "all times just as it is seen from all places, and by the same means."[21]

Merleau-Ponty's analysis indicates that the thing persists in time, as well as in space, as a sum of experience. Some of these experiences are based in materiality and embodied perception, others as communicative representations; similarly some exist in the present, others in the past or the anticipated future. To explore the relational structure of the screen, we need to understand these scales of experience as coexistent – as contributing significantly to a greater relational field.

Such an understanding holds the thing, and the term that refers to it, as a population of experiences. It is a thing populated by individuals on one scale, and able to act as an individual on another. None of these understandings have priority over the others: "taken in itself – and as an object it demands to be taken as such – the object conceals nothing: it is fully spread out and its parts coexist while our gaze skims over them one by one; its present does not efface its past, and its future will not efface its present."[22] Merleau-Ponty's house, then, can be seen as a field. This field includes a composite of the possibilities of the house, from all experience that have been had, and from all experiences that might be anticipated.

The meaning held by the whole remains grounded in individual experience, rather than being the conditions for that experience.[23] Persistence of meaning in this sense can be seen as a mechanism, a process of mapping regions of experience into meaningful wholes.

The ontology of the screen belongs such a region of experience. The meaningful whole of the screen is composed of experiences of things, each able to exist independently that form a larger whole. Yet the screen is not reducible to these individul experiences. The meaning of the 'screen' as a population is different to any individual instance of it, just as the meaning of these instances is different to any individual elements that make them up. Moreover, the screen's ontology relies on these differences. Meaning is held at a certain scale of interaction, where a region of experience is delineated, perceptually bounded into something called a 'screen'. This region might contain spaces, objects, subjects, real things and virtual things as points within its field, but it also relies on generative processes of materiality and agency in the way the region is bound and escapes its binding. A screenic topology allows individual things and experiences to sit side-by-side and to become one another – concept to experience, word to object, virtual to real.

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19. Pheng Cheah writes that "in order to be present, any being must persist in time. This means the form of the thing – that which makes it actual – must be identifiable as the same throughout all possible repetitions. But this iterability implies that any presence is… impossible even as it ... [is] possible." Pheng Cheah, "Non-dialectical Materialism" in *New Materialisms: Ontology, Agency and Politics* ed. Dianna Coole and Samantha Frost (London: Duke University Press, 2010), 74.
20. Merleau-Ponty writes: "our perception ends in objects, and the object, once constituted, appears as the reason for all the experiences of it that we have had or that we could have. For example, I see the neighboring house from a particular angle. It would be seen differently from the right bank of the Seine, from the inside of the house, and differently still from an airplane. Not one of these appearances is the house itself. The house, as Leibniz said, is the geometrical plan… that includes these perspectives and all possible perspectives; that is, the non-perspectival term from which all perspectives can be derived; the house itself is the house seen from nowhere." Maurice Merleau-Ponty, *Phenomenology of Perception*, trans. Donald A Landes (London: Routledge, 2012), 69.
21. Merleau-Ponty, *Phenomenology of Perception*, 71.
22. Merleau-Ponty, *Phenomenology of Perception*, 73.
23. Heidegger remarks on the role of individual experience in naming: "The naming of the substantive itself always occurs on the basis of a pointing-out. This is a 'demonstration', exhibiting the encountered and the present-at-hand. The function of naming, which is performed in the demonstrative, belongs to the most primordial way of speaking in general." He maintains that 'this' one is "somehow included in every naming as such." Martin Heidegger, *What is a Thing?*, trans. WB Barton, Jr. and Vera Deutsch, analysis by Eugene T Gendlin (Chicago: Henry Regnery Company, 1967), 25.

Boundaries

How do we draw boundaries around the screen to call it a screen? What does this boundary include?

Do we start with the material? The screen is a plane on which light falls, or a system of repeating voids. It is light emitting diodes in an array. It is the LEDs and the wires that connect them. Or the LEDs, the wires, the glass on which they sit, the plastic that protects them. Or all of these and the invisible electrostatic grid, actualised by the current flowing through human skin so to allow the recognition of touch. Or these and the mouse, the keyboard, the radio frequency transmitter or the WiFi connection.

Or is it how the screen behaves? The screen is a projector of light, a filter of sensorial information. The screen is fast or responsive, it reciprocates social behaviour and holds social meaning. The screen is visual, aural, it recognises touch. The screen is virtual, real, subject, object.

Or perhaps the screen is all of these – a frame and an image, an object and a space. Pixels and an object and a space. Pixels, objects, spaces, symbolic meanings.

If these are the parts of the screen, then how do they give the screen as a whole?

Parts and Wholes

Approaching the screen according to its relational structure shows that the screen is a malleable entity. Screens are materially and conceptually decomposable to parts – they are made up of smaller things. These smaller things can be quite different from screen to screen – from apertures to photons to light emitting diodes. But these are not, in themselves, screens. Rather, it is how these things are composed in relation to one another, their ordering, that reveals the screen. That is, the properties of the screen come from the confluence of these parts non-additively. DeLanda notes that, in order to explain this observation, some concept of emergence is required.[24] A concept of emergence allows pixels and apertures to hold properties at the same time as the relations between them generate new things with

new properties. This section reframes the region of screenic experience found in the last section in terms of the emergent assemblage. It begins by looking at the relation between that whole and the parts of the screen at different scales, and introduces the idea of the assemblage to account for how different relata can appear for the same screen in different contexts. It will conclude with a discussion of how boundaries are drawn around screen experiences and territorialised into screenic things at different scales.

Decomposable and irreducible

Emergences allow properties to develop from within things, so that "the whole exists alongside the parts in the same ontological plane."[25] Emergence allows the properties of things to remain immanent rather than transcendent. In this way, the screen can be made up of smaller things, but have properties and capacities that belong to the whole *per se*. The screen can also hold properties of its own within the larger whole of the social realm, or the technological realm. The screen can remain alongside the pixel and the aperture, and alongside the larger environment of which it is a part. Each of these scales can then be incorporated into the screen's relational structure.

In this way, the screen is decomposable, in the sense that smaller parts can be found within it. But it is also irreducible in that these smaller parts do not simply 'add up' to the whole.[26] If the whole is decomposed into its parts, its properties cease to exist.[27] That is, although the screen

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24. Properties, then belong to emergent wholes, and can arise and dissipate along with these wholes: "if properties are viewed as produced by the interactions between components, and their existence and endurance explained by the continuity of those interactions, then the properties are contingent: if the interactions cease to take place the emergent properties cease to exist." DeLanda, *Assemblage Theory*, 12.
25. DeLanda, *Assemblage Theory,* 13.
26. Heidegger explored concepts of decomposability and irreducibility, saying "the interior is always again an exterior for the smaller and smaller particles." In his example, a piece of chalk can be cut and cut again until it is powder, and even then smaller components can be identified through molecular analysis. But what is left is now "is no longer our chalk, i.e., we can no longer write with it on the blackboard." Heidegger, *What is a Thing?,* 20.
27. The thing is defined not by its properties, but by the emergence of properties at particular scales and the contextual relation between scale and property. The thing is explained through "irreducibility and decomposability, a concept that makes the explanation of synthesis and the possibility of analysis intelligible." DeLanda, *Philosophy and Simulation*, 184. In this way, removing one part destroys the whole, but each part retains its capacities as an individual.

is materially reducible to pixels in that these smaller things 'make up' the screen, it is not effectually reducible in the same way. The screen is lost if all that appears is a collection of pixels. The *Behaviour Boxes* showed the importance of this relation. Although the *Behaviour Boxes* each expressed some of the relations of the screen, these were decomposed into parts that were disconnected from one another. The effect of the screen, the whole to which the parts were parts, disappeared with this disconnection.[28]

Redrawing boundaries

The screen is not malleable solely because the term 'screen' is malleable as a component of language. There are certainly slippages and side-steps in how the term refers as individual referents move in and out of its population; but there is also an ontological malleability to the experience of the screen. If regions of experience are bounded as a perceptual process, then the way these boundaries are drawn is open to change as experience changes. As these boundaries are drawn and re-drawn, what is and is not included within the field of 'the screen' is itself open to slippage.

Ryoji Ikeda's *Supersymmetry* (2014) demonstrates the ways in which the boundaries around the screen can be manipulated. Ikeda's installation begins with a dark room and a beeping sound similar to that of a radar. The installation is in two halves.

The first, "experiment," is presented as three tables, each composed of a backlit tray, a set of clear or metal ball-bearings, and a scanning arm. As the backlit tray is put into subtle motion, the ball-bearings move across its surface, flocking in unpredictable ways. This movement releases its own sound, which is picked up and projected through the space. The flocking ball-bearings act as information, producing pattern on the surface. As a planar, information-carrying surface, each of these tables is, quite comfortably, able to be called a screen. Then the backlight flickers and disappears, and particles of red light begin to move across the plane in lines. The materiality of the screen's information changes: from the metal and plastic ball-bearings, to patterns of light. The

sound changes along with it – from the radar beep to the sound of improperly connected audio equipment, like plugging a speaker jack into a computer as an audio file is playing. The material of the screen has fundamentally changed, but is still located in the same space. The scanner arm then moves across the surface and the tilting stops. The beeping starts again, but the ball bearings lay still.

The second part of the installation, "experience," consists of two banks of screens, one to either side of a central walkway. Each bank is itself composed of multiple screens: a continuous projection behind, on which messages are being decoded; and sixteen smaller, individuated monitors in front that depict a vertically moving sequence. Each of the monitors is discrete, but they appear to be working together. They also appear to interact with the continuous projection behind – they change frame and sequence as the projection appears to 'finish' a task. Flashes of white light then begin to move across the continuous projection, the scanning sound stops again. The monitors and continuous projection show footage taken from the table trays of ball-bearings. The sound of this rolling fills the room.

Ikeda writes that "one central theme that I have always been keeping in mind when creating works is 'continuation and discretization.' Even things that seem to be continuous are certainly all composed in a discrete fashion. Continuation is just an illusion produced by the scales of things as we perceive them."[29] Supersymmetry, the result of Ikeda's residency at CERN, challenges the pre-existence of the discrete. The boundaries of the stable, fixed 'screens' in Ikeda's installation are constantly being redrawn. The 'screen' shifts from the table-screen (each of which has two materialities), to the monitor, then to the series of monitors, which seem to have a singular intent in screening. The screen then shifts to the continuous projection, and then to the entire bank of screens. In the end, the synchronicity between the banks of screens and the

28. It became "an aggregate in which the components merely coexist without generating a new entity." DeLanda, *Assemblage Theory*, 12.

29. Ryoji Ikeda, "Ryoji Ikeda — Supersymmetry." Ikeda continues to say that Superposition, the work on which Supersymmetry is based, deflects the idea that continuity is an illusion. He refers to the quantum computer in this respect – where the discrete 0 and 1 of binary code – on or off, yes or no – is replaced by the qubit, which is a superposition: both 1 and 0 at the same time.

tables are emphasised by the soundscape, and the 'screen' moves to include the entire room, immersing the visitor. Moreover, each of these screens at different scales coexist with the others – the screen is both continuous and discrete, in all of these places and between them. A relational structure needs to take account of how these boundaries become redrawn – how one screen is enveloped by another, or how one fixed relata can become another.

Strata to assemblages, assemblages to strata

DeLanda, in his discussion of Deleuze and Guattari's assemblage, defines things according to two extreme states – the strata, and the assemblage. Stratification occurs through a dual process, which Deleuze and Guattari referred to as a "double articulation."[30] The first is a filtering process of "loosely sorting the raw materials into sedimentary layers." This is an act of making homogenous. The second is a process of consolidation, of "cementing those layers into a more enduring whole."[31] This is an act of unification and making permanent. The processes by which stratification occurs are terriorialisation, a bottom-up effect of finding boundaries; and coding, a top-down effect of regulating boundaries once formed.[32] The strata that result represent a coalesced mass with maximum homogeneity. To consider the screen as a stratum is to approach it as a homogenous entity, a generality with a transcendental essence. The 'properties' of the screen—as—relatum, such as its division of the real and the virtual, its displacement, and its attention-grabbing, result from looking purely at this generality.

The assemblage, however, acts as a counterpoint to the strata. Assemblages are gained from strata by deterritorialisation and decoding – by re-introducing difference within the strata whilst maintaining it as a whole entity. Parallels can be drawn between these mechanisms and the effects of breaking and alterity in the previous chapter: these two behaviours destabilised the stratfied screen, introducing a difference that threatened the identity of the whole. Screenic effects were still present in the face of these behaviours, but the whole was less able to be considered as a screen. Though Deleuze and Guattari approach the strata and the assemblage as separate, opposed forms,

DeLanda suggests a modification to show them as the same form expressing different values of territorialisation and coding. He sets up territorialisation and coding as paramters of an assemblage. DeLanda stresses the ability to move between strata and assemblages by turning 'knobs' corresponding to values of territorialisation and coding.[33]

One of the 'knobs' in in DeLanda's conception is territorialisation, "a parameter measuring the degree to which the components of the assemblage have been subjected to a process of homogenisation, and the extent to which its defining boundaries have been delineated and made impermeable."[34] Adjusting the degree of territorialisation in a stratum or assemblage means increasing or decreasing the sameness within the relatum; extending or reducing its boundaries (or, perhaps more accurately, increasing or decreasing the permeability of these boundaries). To find an assemblage from a stratum, then, means finding the heterogeneity within the thing, and the points at which it changes into something else. DeLanda thus describes strata and assemblages as "phases, like the solid and liquid phases of matter."[35]

Territorialisation, as a process, "refers not only to the determination of the spatial boundaries of the whole… but also to the degree to which… an assemblage homogenises its components."[36] Although territorialisation

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30. Deleuze and Guattari, *A Thousand Plateaus*, 47.
31. DeLanda, *Assemblage Theory*, 103.
32. Territorialisation is a bottom-up mechanism, a means of drawing boundaries, of making experience into things. Coding, however, happens in the opposite direction. It refers to "the role played by special expressive components in an assemblage in fixing the identity of the whole" DeLanda, *Assemblage Theory*, 22. Coding is a top-down mechanism, a type of ritual restraint of the whole on the parts. In this way, strata are "acts of capture," once formed, they maintain themselves, "striving to seize whatever comes within their reach." Deleuze and Guattari, *A Thousand Plateaus*, 40. This chapter focuses on territorialisation more than coding because it defines a way of linking perceptual shifts to the shifts between relata.
33. DeLanda writes: "if one member of these dichotomies can be transformed into the other then the oppositions can be replaced with a single parametrised term capable of existing in two different states. This yields a different version of the concept of assemblage, a concept with knobs that can be set to different values to yield either strata or assemblages (in the original sense)." DeLanda, *Assemblage Theory*, 3. DeLanda's 'knobs' imply a degree of human control over the process over stratification and destratification.
34. DeLanda, *Assemblage Theory*, 3.
35. DeLanda, *Assemblage Theory*, 19.
36. DeLanda, *Assemblage Theory*, 22.

is not dependent on humans, when looking at assemblages of which the human is a part, it is not difficult to see territorialisation as a quasi-autonomous perceptive process in which things are 'sorted out' into homogenised groups.[37] Territorialisation involves the emergence of boundaries around regions of similarity, and the reduction of difference within this region until presented with a homogenous whole.

Territorialisation starts with an assemblage – a "heterogenous population of sense impressions, and of the low-intensity replicas of those impressions (ideas)," which undergo sorting and assembling "through habitual application of certain operators to the ideas."[38] DeLanda's use of the word 'habit' implies a personal nature to the way these processes are enacted, and a sense of repeatability or iteration in time. In his discussion of the formation of the subject, DeLanda notes habit as an important part of this process, as a mechanism that has propensity towards drawing boundaries in a certain way.[39]

Habit is the "main form of territorialisation" in the formation of the subject, as it is "the process that gives the subject its defining boundaries and maintains those boundaries through time." The application of habit in drawing boundaries around things in perception gives rise to relata at the same time as giving rise to subjectivity. This is a perceptual process that is part of the human relation to the world (and to ourselves). Particularly, habit projects toward the future in anticipation of similar occurrences. In this sense, DeLanda's 'habit' is akin to a material directedness, but can also account for continuity of meaning across differences as it anticipates changing experiences.[40] Massumi's description of the "implicit form" of a thing, for example, establishes a sense in which the thing is continuous across different experiences of it. He describes implicit form as "a bundling of potential functions" – a description of "the effective presence of a sum total of a thing's interactions minus the thing."[41] This generalised understanding is a *potential* thing: it is built on experiential encounters in anticipation of the next encounter. Anticipation can shape an understanding of the screen that is both material and immaterial, both specific and general.

All pixels are the same

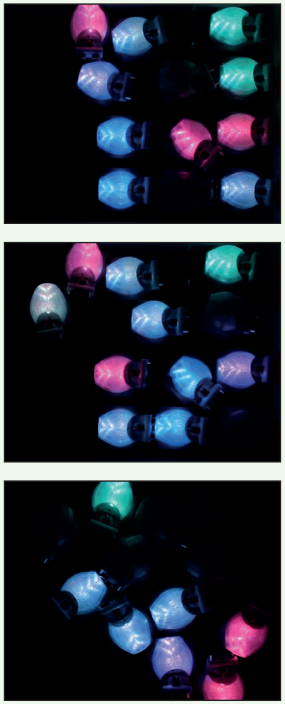


Fig 41. *Distributed Pixels.*

> [H]omogeneous and closed ... these materials hide from view the full repertoire of self-organizing capabilities of matter and energy. On the other hand, if the material is far from equilibrium ... or if it is complex and heterogeneous (that is, if the differences among its components are not canceled through homogenization) the full set of singularities and affects will be revealed, and complex materiality will be allowed to manifest itself.
>
> *Manuel DeLanda*[42]

At the scale below the screen, there are ordered arrays of things – light emitting diodes, apertures, or a uniform thickness of chemical deposits on a surface. The emergence of the screen relies on the sameness of these things.

All pixels are the same. They are made of the same things, they respond in the same ways. Or maybe it is more that any difference between them doesn't matter – that any difference needs to be downplayed because the screen is an effective whole. When I notice a pixel, it's just one of many... until it isn't. A reduction in the sameness of pixels, stressing the difference between these identical things, means the disappearance of the screen and the re-emergence of the pixel in its own right.

37. Deleuze and Guattari use many non-human examples of territorialisation. Of the becoming-orchid of the wasp and the becoming-wasp of the orchid, they write "each of these becomings brings about the deterritorialisation of one term [orchid or wasp] and the reterritorealisation of the other; the two becomings interlink and form relays in a circulation of intensities pushing the deterritorealisation even further." Deleuze and Guattari, *A Thousand Plateaus*, 10. It is not just the terms that are de- and re-territorialised – the material of the wasp becomes orchid as it carries pollen, the material of the orchid becomes wasp through formal mimicry.
38. DeLanda, *Assemblage Theory*, 26.
39. "A subject crystallises in the mind through the habitual grouping of ideas via relations of contiguity; their habitual comparison through relations of resemblance; and the habitual perception of constant conjunction of cause and effect that allows one idea (that of the cause) to always evoke another (the effect)." DeLanda, *Assemblage Theory*, 26.
40. Habit "yields a determinate duration for the lived present of the subject" and "generates a sense of anticipation" of repeatability. DeLanda lists both the "routine mental labour" of assembling wholes as well as the "biological machinery" of sensation as material components of habit. DeLanda, *Assemblage Theory*, 27.
41. Massumi, *Parables of the Virtual*, 34-5.
42. Manuel DeLanda, "Material Complexity" in *Digital Techtonics*, ed. Neil Leach, David Turnbull and Chris Williams (London: Wiley Academy, 2004), 19.

Screens rely on an expression of difference across pixels, too. Each pixel holds a different place in the array, each holds a different colour value at any given time. Without this difference, patterns can't form, information can't be carried.

Some Assembly's pixels, its bots, are all the same. Each holds the same components – a colour sensor, an ultrasonic detector, wheels, motors, chips, wires, lights. Each has the same capacities – void evade(), void goForward(), void goBack(), void testDistance(), void coloursense(), void receiveColour(), void colourdisplay(). But many differences arise between them. In the beginning, the difference between the bots is temporal and spatial, it is about position and speed, much like an LCD. Something like a screen arises from this condition. But as the difference increases, the screen falls away. The bots are individualised, each individually expressive. The scale of emergence is changed – from whole to part.

Moving between strata

In other words, things are made from other things through a process of emergence, through which properties are created that do not belong to any one part but to the new collective as a whole. Once these properties have emerged, they start to form identities: these in turn become reinforced through processes of territorialisation and coding. The homogenised and sedimented strata appear to us as concrete things, and are the means by which continuity of meaning can be found. But in revealing things this process conceals movement between strata; how smaller parts can be assembled into larger wholes.

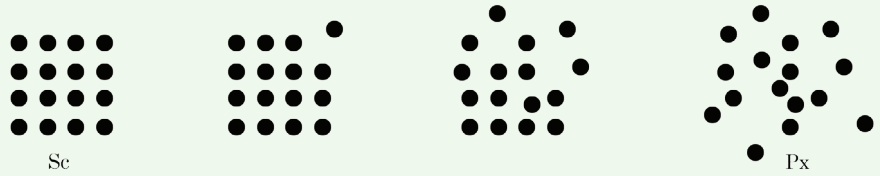
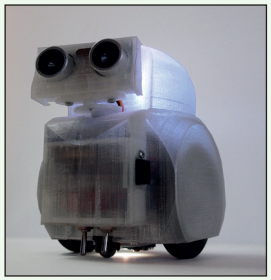


Fig 42. *Screen to Pixels.*

43. DeLanda, *Assemblage Theory*, 13.
44. Massumi's 'event-space' is similar to a field of possibility: it is a non-Euclidean space defined by the changes and movements that occur within it. Massumi describes these spaces as "intercoporeal" and "abstract," and continues to define Euclidean space as a 'fixing' of event-space: "[w]hat we think of as Euclidean space is a mutual holding in relational stability of incorporeal event-spaces, relative to kind of movement, scale, and speed." Massumi, *Parables of the Virtual*, 204.
45. Massumi writes: "potential… is a modification of a space. The space is the literal field, the ground between the goals. Any and every movement of a player or the ball in that space modifies the distribution of potential movement over it." Massumi, *Parables of the Virtual*, 75.

A great man (a misreading)

Fig 43. *Hero Shot.*



"Historical explanations are inevitably shaped by the ontological commitments of the historians who frame them. These commitments may be roughly divided into two classes… depending on which of the terms of these binary oppositions are favoured: 'the individual versus society', 'agency versus structure', 'choice versus order'. Taking the side of the first terms in these dichotomies yields narratives in which the actions and ideas of persons, typically 'great men', are the main factors shaping events"

Manuel DeLanda[43]

Some Assembly was an ordered effect, a community of bots, a system, a functioning whole. Each individual bot working together for the greater good, each with their own place, a cog in a well-oiled machine.

One fateful cycle, one bot grew tired of his place and began to turn out of it, facing a different direction, changing views. The Turner, as he came to be known, changed the very nature of the whole. The patterns exhibited by the group were morphed, skewed. No longer a tight-knit community, the bots lost faith in the whole. They began to back out of their places, looking around the field for new interactions. The whole was lost, but new individual freedoms were found.

Or perhaps the change was inevitable, hard coded in to the very structure of the system. Perhaps it was only a matter of time before the whole tended towards disorder, no longer able to maintain its codes and structures of control.

Massumi discusses changes in event-space in similar terms to shifting strata within the field of possibility. [44] He writes of the event-space of a football game as being defined by potential, where the players modify the ways that the field can be enacted by placing the ball and their bodies.[45] He then looks at how this potential is changed when viewed from home on the television. Massumi notes that, within the event-space of the game, the individual actualisations of the game (the game events) fold back in on the game's potential (its event space). The event-space of the game folds back in on itself, with every movement

restricting and opening new possibilities for movement. This he sees as a form of coding – the game becomes reproducible by the way that possibilities for movement emerge and disappear, and is considered "the 'same' by virtue of occurring in what has become a recognisable space."[46] The physical space of the field becomes a typology through the reproducibility of the game.

By contrast these same events reach outward when broadcast – manipulating and changing other events within a new possibility space. Through broadcast, the event of the game if 'freed' from its event-space of the field by acts of "isolation, defamiliarisation, distancing, or decontextualization." The action of broadcasting the game on television transmits the game into a new event space: "this proliferation crosses a qualitative threshold… [w]hereas self-referentiality has to do with reproduction, event-transitivity has to do with differentiation." When the game is transmitted, it changes nature. When it comes into the home, it changes nature again.[47]

For this reason, Massumi denies that television is a mode of access to things, that it is a "window on the world."[48] The new event-space, in which the game is being watched from home, includes the content of the home as well as the content of the screen and the content of the game *per se* – the assemblage has been re-inscribed to include the social and material relations of the home. The unfolding of the game within the field is now inseparable from the unfolding of domestic life. The events that arise in this situation – along with the determinations made within them – are fundamentally different. The television, in this sense, could be thought of as a deterriorialisation machine – a way of disturbing existing strata and introducing new possibilities to restratification.

Parallels can be drawn between the sedimented strata and the conception of the relatum developed through the previous chapters. To follow the logic of a relata-based understanding the strata are what is visible, what is present to the perceiving body, and what persists in time. These unified wholes are indivisible in this way,

they are an apparent reality. Relata hold the same role in this form of understanding. Massumi's example looks at how the television allows the unfolding of one event-space into another, affecting the abstract space of movement as an entity in itself. His choice of the television is a fitting stratification, though not the only one he makes in regards to the transduction of event space. He comments that "[t]he images are also transducers. And they contribute to the catalysis of the domestic event. The television set combines sign, part-object, and part-subject functions."[49] The movements between strata occurs within the television as well as outside of it. From these movements, stable relata are deterritorialised, and the screen emerges as something else: on scale above the screen (such as Massumi's domestic territory), or below the screen (as image, object or pixel).

The relations formed by these relata are reflexive because of the strata's reliance on the things it exists between. Deleuze and Guattari note the reliance of any stratum on those that surround it, saying that "it would be a mistake to believe that it is possible to isolate this unitary, central layer of the stratum, or to grasp it in itself, by regression. In the first place, a stratum necessarily goes from layer to layer."[50] Likewise, relata can only be defined in terms of their others, and their relations to those others. The logic of the relation-based understanding can come to the same conclusion – both relata and strata are drawn out of a relational flux and made into homogenous wholes. Accrued experience has tested these relata and solidified them in processes of territorialisation. More than this, once found and sedimented, the relata begin to act downward on the field of possibility, coding the way it is approached. This was seen in the relata-based analysis, where to maintain the integrity of

46. This folding-back corresponds to a coding: "coding and codification are forms of event self-referentiality – the folding back of the event onto itself, toward its repetition. The folding back, the self-referencing, is what converts the event into an event-space." Massumi, *Parables of the Virtual*, 83.
47. "In the media interval, the event is material but incorporeal immanence (an electron flow) moving through a dedicated technological milieu. When it is analogically reexpressed in televisual images, its conditions have drastically changed. Its substantial elements have been homogenised and reduced to fit sound speaker and screen." Massumi, *Parables of the Virtual*, 84.
48. Massumi, *Parables of the Virtual*, 84-5.
49. Massumi, *Parables of the Virtual*, 81.
50. Deleuze and Guattari, *A Thousand Plateaus*, 50.

subject and object relata in dichotomous relations, other relata needed to be split off and sedimented – a subject-bound agency, and an inert materiality.

Assemblages and scale

When considering the relational structure, scale becomes particularly important. Just as the strata move from one layer to the next, parts and wholes are always nested. Individual instances of screen experiences make up 'the screen' as a whole, which has properties different to any one of those instances; but these screen instances are themselves reliant on an ordered relation of pixels and apertures for their consideration as a whole. The 'screen' is generated through a "recursive application of the part-to-whole relation,"[51] and may enter into other assemblages, such as the screen-bearing objects of chapter two that denied being screens themselves.

Scale is an important issue for the relational structure of the screen in regard to how it persists as meaningful. The assemblage is always an assemblage of other assemblages, so that the screen – which is now a collection of pixels, and now a barrier, and now a connection, and now a space, and now a thing in my hand – does not change through these iterations. The 'screen' is one individual amongst this cluster of other individuals, each a different entity defined in relation to the others. This cluster constitutes the screen's field. It is only where the borders are drawn that shifts, and this is a matter of scale.

The relations between the whole and the part are nested within other wholes and parts. The thing is simultaneously its whole and its parts – it exists alongside its parts, not above them or separated from them. Using the term 'nesting' in this sense might be misleading as it implies a hierarchy of interiority. The term as used in this chapter is not intended to denote a hierarchy, but a reliance of parts on wholes and vice versa. The screen is reliant on pixels and apertures as parts just as pixels and apertures are reliant (at least in part) on the screen. The effect of screening happens across pixels; across the repetition of apertures.

More particularly, it is the ability of these pixels and apertures to behave differently, to be different, that gives rise to the overall effect. DeLanda notes particularly that intrinsic relations, those which constitute the identity of their relata, "cannot respect the heterogeneity of the components, but rather tends to fuse them together into a homogenous whole."[52] Rather, extrinsic relations belong to the assemblage, relations of difference and symbiosis in which each part maintains an identity alongside a whole that establishes its own identity.

This means that it is not just the properties of the thing that define it at its scale, but also its behaviours; or, more accurately, its potential behaviours. DeLanda defines these as 'tendencies' and 'capacities'.[53] The effects of the screen belong to the assemblage of pixels or apertures, each of which maintains a heterogeneity. In this sense, the agency of the assemblage also belongs between these parts, so that "the efficacy or effectivity" to which the term 'agency' traditionally refers "becomes distributed across an ontologically heterogenous field."[54] The ability of the thing to affect – its tendencies and capacities – belong to the difference between its parts. It is also responsible for the assemblage being stratified at a particular scale. That is, the scale at which an effect is perceptually whole is the scale at which it becomes bounded: if a difference is recognised between two distinct spaces, the screen arises in perception as responsible for this difference. If one of these spaces is improperly rendered or sensorially restricted, the pixel that

51. DeLanda, *Assemblage Theory*, 70.
52. DeLanda, *Assemblage Theory*, 2.DeLanda defines intrinsic relations as those where the identity of the role is determined by the relation. Importantly, the way this relation plays out is socially coded. He uses the example of filial relations in this regard – a person cannot be a parent without a child and vice versa, and the role of both parties carries certain social meanings and obligations. Extrinsic relations, by contrast, do not constitute the identity of the related parties – they allow them to remain heterogenous. DeLanda uses the example of political alliances in this regard. The way a political alliance plays out is not as strongly coded – the actions it prescribes are determined within the alliance itself (and thus by the assemblage). A parent is still a parent, whether or not they are fighting with their child; but parent and child may not remain allies.
53. DeLanda writes: "it is important to distinguish two different ways in which technical objects may be characterised: by their properites and by their capacities." The properties of an object are actual – material expressions. Capacities, however, are either currently occurring as an event, or potentially occurring at another rpoint in time. The event is double, "because the capacity to affect must always be coupled with a capacity to be affected." DeLanda, *Assemblage Theory*, 73.
54. Jane Bennett, *Vibrant Matter: a political ecology of things* (Durham: Duke University Press, 2010), 13.

arises in perception as affecting the quality of spatial representation. In each case, an individual is defined that generates and effect. DeLanda comments that "as an ontological category, the term 'individual' has no preference for any particular level of scale."[55] None of these effects belong to an indivisible individual, but to different assemblages at different scales, each considered, at that point, as an individual. The differences between the components of an assemblage make them able to relate to one another, and this is how the effect arises across them.

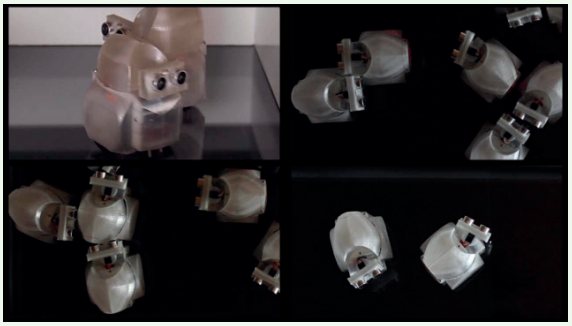


Fig 44. The Problem of Cuteness. [Video, 02:41].

The problem of cuteness

I'm trying to keep a hold of the screen, to see *Some Assembly* as a whole, across its pixels rather than in them. But I keep getting thrown off, waylaid by the bots. They're cute, and it poses a problem for the screen.

There's a group of three chasing each other around the board. Here, two bots face off against one another, locking horns and circling around the field in an aggressive display. One of the bots is a loner and a bully – moving over to different groups, trying to pick fights. Other bots seem keen on each other, trying to get ever closer or moving along side by side.

How can the screen appear in the face of these creatures, in the face of their interactions with each other, their affect and expression?

Perhaps the screen should be menacing, intimidating and closed. Black-boxed so the everyday goings-on of the pixels can't be seen.

The individual group

In terms of this project, the assemblage shows that relata are always composed of other, nested relata; and it is the difference between these constituent relata that are responsible for the larger relatum. But in the appearance of this larger relatum, the differences between the smaller relata are downplayed – the smaller relata are homogenised to strengthen the unity of the larger relatum; to make it more actual, more concrete. If the pixels appear to be acting toward a common goal, they are transcribed together as a unified relatum of the screen. Any differences between pixels are homogenised. If the differences in the actiona of the pixels passes a critical threshold, the screen stops being a screen and becomes a collection of individual pixels. If the television 'breaks' by forming deadspots, then the relation between pixels become apparent, and the dependency of the emergent whole on these relations.

Nesting ensures that processes of territorialisation and coding happen both from without and within, from the parts to the whole, and from the whole to the parts, so that the way that assemblages develop and dissipate "will be partly autonomous and partly influenced by the environment, created by the larger assemblage of which it is part."[56] The dead pixel affects the image as the whole of which it is a part, forcing a deterritorialisation at the scale of the screen, and a reterritorialisation at the scale of the pixel.

55. DeLanda, *Assemblage Theory*, 140.
56. DeLanda, *Assemblage Theory*, 72.

Designer as environment

At any given level causality operates in two directions at once: the bottom-up effect of the parts on the whole, and the top-down effect of the whole on its parts.

Manuel Delanda[57]

I am part of two very different assemblages with *Some Assembly*. As I watch it perform, I exist with it at a certain scale, where its behaviours affect my experience. As its designer, I belong with it at a larger scale, as part of the environment which shapes it.

My design intent for *Some Assembly* is an environmental factor, something which restrains the system's autonomy as it shapes its behaviours. I codify as I code, programming rituals and sequences that restrict what can emerge from the bots. These rituals and sequences, in turn, are restricted by the materiality of the components, the grammar of the script.

Once *Some Assembly* is made, our relation changes. The system exercises some autonomy over and above my intent. From the materialities and ways of workings of the components that make up the pixels emerge behaviours I didn't expect – lagging responses to the environment, individual differences in movement. From the code which drives each pixel emerge eccentricities in timing—points where the bots can get stuck or think (erroneously) that nothing is in front of them. Perhaps I try to help them out, turning them around so they can move out again, keep the system moving.

From the bottom up and the top down.

Assemblages, then, are each an individual as well as being comprised of individuals. Although they occur at different scales, they occur alongside one another, their ontological status is the same. Because the ontological status of the whole and the parts is the same, they can interact even if they have a different scale. I can interact with the community of which I am a part, and the pixel can likewise interact with the image it produces. This means that the components of an assemblage retain a

sense of autonomy and a capacity for difference. Deleuze and Guattari describe this structure using the language of strata, saying that "in short, the epistrata and parastrata are continually moving, sliding, shifting, and changing on the… unity of composition of a stratum." The relational structure of the screen is found in the move from one assemblage, and one relatum, to another; in how the strata "are swept away by lines of flight and movements of deterritorialisation" by perceptual mechanisms that allow them to be "shaken by phenomena of cracking and rupture;"[58] so that other perceptual differences can be reterritorialised at different scales.

The limits of pattern

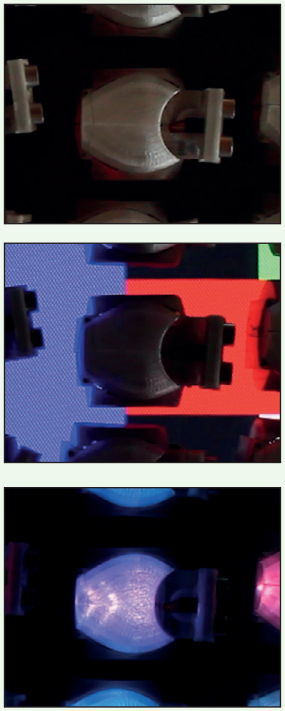


Fig 45. *Regional Specificity.*

The object 'constancy' at the basis of cognition is not so much a persistence in existence of unitary things as it is ratio between perceptual variations: the ratio between habit (pattern of reaction) and the sea of chaos in which it swims.

Brian Massumi[59]

As I stand and watch the bots perform, there is only so long I can keep a hold of the screen. The patterns that I see – the synchronised responses of the bots to their environment, the distribution of colour across the field – start to decay. There's a moment where I can no longer attend to the patterns presented there.

In the beginning, the darkness carried information and effect, the lightness interrupted it. Now the opposite is true. The darkness interrupts the light. It no longer matters what colour the bots show me or how synchronised their response, the information is carried elsewhere. The pattern is now in their interactions with each other – their groupings, actions, and movements towards one another.

The bots have limits to their pattern attendance too. As one bot lands on the borderline between a zone of blue and a zone of red, he can no longer process what he's seen. He takes a guess at purple.

57. DeLanda, Assemblage Theory, 71-2.
58. Deleuze and Guattari, *A Thousand Plateaus*, 55.
59. Massumi, *Parables of the Virtual*, 150.

The relational structure relies on things emerging from other things. As such, the potential of a relatum, the ways in which it can take part in other things, becomes just as important as the properties it is currently exhibiting. Instead of being understood solely in terms of properties, any scale of assemblage also has tendencies and capacities, abilities that can be manifested even if they are not currently *being* manifested. These unmanifested (relational) capacities and tendencies from which new wholes emerge define the relational structure of the thing.[60] In other words, the relational structure exists in how one thing moves to become another, as a sort of field of possibilities.

Persistence in time and the relational structure

Rather than focusing on how the term 'screen' retains a continuity of meaning, a commonality of screen-ness across a variety of forms, the focus is now how the field of the screen's possibilities can include a variety of forms and capacities across temporal and spatial distributions. As DeLanda notes, "assemblages are characterised by enduring states defined by properties that are always actual… But in addition… assemblages also possess dispositions, tendencies and capacities that are virtual (real but not actual) when not being currently manifested or exercised."[61] The meaning of the screen is not defined by common properties, but by the field of possibility that generates each instance of the screen. That is, the screen is defined by a tendency that belongs to the assemblage of 'screen' as a population, which includes all possible instances of the screen. This section will begin by establishing that the different scales of the screen are held together by a relational structure that defines the field of possibility of the screen. It will look at tendencies and capacities as virtual entities that define regions of screen possibility, before concluding by establishing that the screen's possibility space can be mapped.

What isn't there

Unlike properties, the tendencies of the screen do not have to be currently manifested in order to remain real, they only need to be part of the screen's field of possibility. The capacity of the television

to broadcast, for instance, does not cease to exist once the television is switched off. Although it properties have changed – for example, in terms of the light and sound it emits – its capacities remain the same. The capacity for the screen *to* screen is "not an enduring state," rather an event that happens at some times and not at others.[62] That is, it needs to be possible for screening to happen at a point in time. Whether or not that point of time is *now* does not matter.

Moreover, it is these tendencies and capacities that define the relational structure of the screen. The screen, then, may be embodied by its materiality, in that it has material properties that belong to it as a 'screen', but the 'screen' is also *expressed by* this materiality. DeLanda uses the example of a knife to demonstrate this point. The knife has an actual sharpness, which is a material property of the blade's edge. But it also has the capacity to cut, which is still there whether or not cutting is happening. Moreover, the capcity to cut is contingent, because "the capacity to affect must always be coupled with a capacity to be affected" – that is, the knife cannot cut without something that can be cut.[63] The capacity to cut is expressed by the materiality of the blade, its sharpness, but the knife must enter into a new assemblage to exercise this capacity. The knife's cutting, then, is just as immaterial as it is material. Likewise, the capacity of the screen to screen is expressed by its material make-up – the order of its pixels and the ordering of information – but this is not the sum total of its screening.

(Im)material

In looking for the confluence between the screen as an object and the screen as a space, for how these two materialities interact, I have now

60. DeLanda defines the possibility of capacities as having a concrete structure: "the part of the explanation of emergence that depends on mechanisms involves the actual manifestation of tendencies… and the actual exercise of capacities ... The mechanism-independent component of an explanation, on the other hand, demands clarifying the status of tendencies and capacities when they are not actually manifested or exercised. We could, of course, characterise that status as that of a possibility but that would be too vague: an unmanifested tendency and an unexercised capacity are not just possible but define a concrete space of possibilities with a definite structure." DeLanda, *Philosophy and Simulation*, 17.
61. DeLanda, *Assemblage Theory*, 108.
62. DeLanda, *Assemblage Theory*, 73.
63. DeLanda, *Assemblage Theory*, 73.

arrived at an idea of materiality that turns materiality itself into an expression of the immaterial. I am looking for the screen not in the physical but in possibility, the virtual. But this is not a virtuality that is opposed to reality – Delanda makes clear that the tendencies of the screen belong to the real (just not the happening right now). This is a virtuality that is a part of reality, a potential for being which is as much 'real' as the actuality of the thing. In looking at the relational structure, materiality has become a tendency, not just a series of properties held by this screen in the present moment, but also a more general directedness toward acting. The 'real', then, includes the potential as well as the actual because it includes the process of materialisation; of turning the potential into the actual.

The terms 'virtual' and 'possible' have been used in these last few paragraphs in a different way to their previous appearances. In the first chapter, the 'virtual' was used to refer to an entity that belonged to an ontological plane different to that of reality. That is, the 'virtual' in the relata-based analysis could never become real; there was no potential crossover between the two because of the underlying assumptions by which they were defined. The screen posed a peculiar problem to this definition because it existed in two places at once: the material of the screen and the image it displays overlap in space and time. This overlap was unallowable as it directly challenged the understanding of space as a grid in which things are positioned. To allow this space to continue, the 'virtual' was moved to a different experiential plane, and the screen became a portal to this plane.

In the present discussion, the virtual is being conceptualised as a part of the real, the two now being understood on the same ontological plane. The virtual and the actual now coexist in the real; the actual being that which is currently manifested, and the virtual being that which has the capacity to be manifested. This change has strong implications for understanding the screen. The conclusions of chapter one, which place the screen as creating a gap through framing or suturing, have to be abandoned. These roles for the screen rely on a separation of the real and virtual rather than their coexistence. Instead, it seems the screen

might play a role in the actualisation of possibility – not in transposing the virtual to the real, but in expressing inaccessible elements of the real.

The key to deciphering the role of the virtual in the real, for the purposes of this project, lies in structure. Deleuze and Guattari hold that "the reality of the virtual is structure."[64] That is, it does not matter that some elements are not actual, so long as they have defined structural relations to elements that are. Such a structure allows them to become actualised at some point, and this ability to be actualised is what makes them real, whether or not it ever actually happens. Like DeLanda, I take a temporal reading of this relation, using the term 'possible' to describe this structural space.[65] The screen as an assemblage includes not just all previously instated instances of its materiality, but also all of the materialities it might at one point in time include and display. These I refer to as its possibility – a cluster of actual relata and potential relata (that may be actual at some other time) that sit within a structure. This structure is the means by which the screen persists in time and retains a continuity of meaning.

The possibility space of the screen

The process of territorialisation, along with the lines of escape from territories that cause a deterritorialisation, define a thing which is malleable and scalable. The pixel belongs to the screen just as the aperture does because the screen emerges from their interaction. The point of rupture (where the pixel becomes the screen and back again; or where the screen becomes the space and back again) is the most revealing. This point is where the thing reaches the limits of its field

64. "The virtual must be defined as strictly part of the real object… the reality of the virtual consists of the differential elements and relations along with the singular points which correspond to them. The reality of the virtual is structure." Gilles Deleuze, *Difference and Repetition*, trans. Paul Patton (London: Continuum, 2004), 260.

65. "An unmanifested tendency and an unexercised capacity are not just possible but define a concrete space of possibility." Following from DeLanda, *Philosophy and Simulation*, 17, the term 'possible' is not used in relation to a single potentiality, but in relation to a structural space that defines what is and is not allowed within a territory. The temporality of the possible arises from its non-presence – from the variations of the thing's potential through time. It is not important that these tendencies and capacities are not currently actual, only that they are actual at some point in time. Because 'at some point in time' is indefinable (we cannot say with surety that a certain tendency will never be actual), tendencies and capacities form a space of possibilities.

of possibility. This phenomenon is similar to the one described in the previous chapter in the screen's 'breaking'. The broken screens of *Moubie* and *Gaze Returner* were broken in the sense that they could not appear as screens, they were beyond the limit of the screen, they were past its point of rupture. But what these things didn't capture was the process of de- and re-territorialisation. This sense of transformation, of the coming together and moving apart of assemblages, is how the topology of the field of possibility can be discovered.

In other words, the relational structure needs to include both the nesting of strata, and how they move in assemblages – it needs to look at the relata from within their spatiotemporal relations to other relata. This structure is itself not directly accessible. But as Massumi states, its inaccessibility does not "preclude figuring it, in the sense of constructing images of it." Such an image is created through an overlay of events and possibilities, so that the structure can fleetingly appear "in the cracks between and the surfaces around the images."[66] The image that Massumi discusses is what I am referring to here as a map, an overlay of possibilities that reveal something of the structure which ties them together.

Constructing a map

The relational structure of the screen, then, can be imaged. But care must be taken in assembling this image. In examining the screen from how it is experienced, the space of possibility of the screen is being reverse-engineered – the virtual is being inferred from what is actual. In this sense, the image shows what is probable, not the full scope fo the screen's possibilites. The structural space, as imaged, will always fall short of the full structure of possibility for the screen.[67] More than falling short, however, imaging possibility spaces runs a risk. Hélène Frichot discusses the work of the Deleuzian diagram, a work she describes as "a sometimes violent exertion of thought in the face of the unthought." She writes that imaging a relational field "is always at risk ... it risks falling again into mere opinion, habit and cliché and fixing on channels of knowledge that lead us through nothing but old routines

and repetitive refrains."[68] The diagram – whilst actively drawing and destroying connections as a generative tool – can also sediment them, prodcuing artefacts of knowledge that may be treated as fact. This has a clear disadvantage: the diagram's purpose is to explore what is indeterminate rather than determinate. However it also has an advantage: it allows the image to enter into the very assemblage whose movements it is trying to describe.

In imaging the known instances of the screen, a structure arises *between* these instances. Approximating the virtual from this structure means approaching the possible not as individual instances but as a topology – a space of possibility with a characteristic shape, distribution, and movement. It is clear that the relata form part of the map of the screen. These are the "differential elements" and the "singular points which correspond to them."[69] But it is also necessary to look at the relations between the points – how and when one can be made into the other. The map should include, then, the things that stay the same and the changes that are allowed. This section will discuss how the relational structure of the screen can be mapped by identifying areas of persistence and change. It will then examine the parameters of the screen's map, identifying order, density, and speed as defining the possibility space of the screen as it has been theorised in this thesis.

Invariance and transformation

The two concepts of persistence and change (or invariance and transformation as DeLanda refers to them) characterise the region of possibility. Invariance is "a property's capacity to be unaffected by a transformation."[70] Immanence differentiates an invariance from an

66. Massumi, *Parables of the Virtual*, 133.
67. Deleuze distinguishes between the object as complete and the object as whole, equating completeness with the ideal "which participates with other parts of objects in the Idea (other relations, other singular points), but never constitutes an integral whole as such. What the complete determination lacks is the whole set of relations belonging to actual existence." In this sense, what is actualised is only part of the object, but that part is fully determined. Deleuze, *Difference and Repetition,* 260-1.
68. Hélène Frichot, "Drawing, Thinking, Doing: From diagram work to the superfold" *Access: Critical Perspectives on Communication, Cultural & Policy Studies* 30, no.1 (2011): 1; 7.
69. Deleuze, *Difference and Repetition,* 260.
70. DeLanda, *Assemblage Theory*, 113.

essence: invariances are contextually bound – they belong to particular transformations at particular scales. The screen's map needs to cover these zones of invariance: the particular relata that occur as stable tendencies within the population of the screen. Outside of these stable tendencies, however, is an environment subject to change. Changes in the environment (the specific context of the screen, the larger whole of which the smaller relatum is a part) can introduce thresholds which, once crossed, "destroy" these invariants, shifting the screen toward another zone of invariance. Invariance and transformation thus "capture the structure of a possibility space."[71]

The structure of the field of possibility includes the points of the relata as they are related to one another, but it is more difficult to locate the relations themselves. Once relations are anchored spatially, they become determined – themselves relata. A similar problem arises in this discussion as was discovered in chapter two, which found that the relational plane could not be accessed without a disturbance. When the relational plane was stretched, it gave access to a different set of relata related to the last, not the relation itself. When trying to map transformations *per se* this same problem arises in a slightly different manner: the fixed points of the relata can be located, but how can the relations of transformation be mapped?

DeLanda suggests that what should be mapped is the residue of the relation, the points at which one thing become another. These are the thresholds between strata; the critical points of transition. They are the limits of quantitative change in the relata, after which the thing changes qualitatively. After passing through a threshold, the thing changes in to something else: a screen becomes an inert object, or a collection of pixels assemble into a screen.

Aperture to pixel

> One travels by intensity; displacements and spatial figures depend on intensive thresholds of nomadic deterritorialisation (and thus on differential relations) that simultaneously define complementary, sedentary reterritorialisations. Every stratum operates in this way…"
>
> *Gilles Deleuze and Felix Guattari*[73]

The apertures of the lattice show a range of difference in their sizes and distributions. There's no hard and fast limit to how many of them there are, or how often they repeat, or how large each hole is. But there are bounds outside of which the lattice stops being a screen. One aperture is just a hole. Pinpricks through bricks are just a wall. Within a region, the size, number and distribution of apertures can change without qualitatively changing the screen. But if one of these parameters strays too far, the system is no longer a screen.

The bounds of the lattice in the distribution of its apertures might overlap with that of the television in the distribution of its pixels. One pixel is just a light, one pixel per person is just a locator.

Can an aperture change into a pixel? The critical transition here is probably not about distribution or size, but about material. Where is the point where an array of voids becomes an array of solids? Where points of transmitted light become points of emanating light? I might find myself thinking again of the spatial filter, of information and its connection to materiality. The threshold between the aperture and the pixel is found by looking at different parameters to the threshold between the pixel and the screen. This transition happens on a different map, a different part of the field of possibility of the screen.

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71. DeLanda uses the example of state space diagrams to illustrate the move from one stable tendency to another, such as from water as a liquid to water as a gas. He writes "state space diagrams provide an explanation for the recurrent nature of these states or regimes: they recur because they are stable tendencies… what about the intensive thresholds? These appear in the other space, the control space in which dimensions are assigned to parameter values… a particular distribution of attractors is a topological invariant of state space: it does not matter how we fold, stratch, rotate or project this space, the distribution reins unchanged. But crossing thresholds in the associated control space destroys invariants." DeLanda, *Assemblage Theory*, 120.
72. DeLanda, *Assemblage Theory*, 113.
73. Deleuze and Guattari, *A Thousand Plateaus*, 54.

The structural space of the map is created by "assigning to each dimension of a space the possible variables or parameters a phenomenon can have," where the variables are "the properties of the phenomenon" and the parameters are the "properties in its immediate environment."[74] A topology is then generated by finding the critical thresholds at which change occurs. These critical thresholds sit a dimension below the map, in the same way that a plane acts as a threshold between two volumes, or a boundary line separates two territories of a surface. In a lineal map, the critical threshold is a point; in a planar map, the critical threshold is a line; in a volumetric map, a surface.

The map of the screen, then, maps its relata (the real and the virtual, the subject and object, person, space) onto an environmental field, establishing relations between changes in the relata and changes in the environment.[75] Such a map can capture both bottom-up effects (changes in small relata affecting change in the larger relata) and top-down effects (changes in the larger relata affecting change in the smaller relata), as well as effects that have no discernible direction. The map of the screen is the image of this structural space of persistence and change; it represents the connectivity of a situation, and the properties, tendencies and capacities that may or may not arise from it. It is also, in some sense, the thing itself. More particularly, this map becomes a part of the thing; it overlaps with the possibility space of the screen by virtue of representing it in part. The map is an image of the object as "a systematic stockpiling for future use of the possible actions relating to a thing, systematically thought out on the general level of abstraction."[76]

Twisting and breaking

An assemblage's lines vary in their degree of rigidity, some more territorialised than others… and we can follow the less territorialised one in thought, pushing their deterritorialisation to the limit, until we reach the most deterritorialised component, the diagram.

Manuel DeLanda[77]

There is a difference between twisting and breaking. A break is sudden, it leaves two states – the thing as it might have been before the break, and the broken

thing afterwards. A twist is slow, it has many states. It takes a known structure with known points and begins to remap it into something else. Twisting places stress on the thing, turning it from one thing to another, exposing a point of rupture and allowing it to reveal a boundary.

Some Assembly takes the screen and twists it into a series of individuals, bots that can together be a screen, but can also be something else. It crosses a critical transition between these strata – screen and pixel – at a pace that allows me to watch the transition. I territorialise and stratify what I'm seeing iteratively across this change – now a screen, now a screen, now a screen, now a…

Variables and parameters

Now that what is being mapped has been identified, the next step is to identify how to map it. A map is a spatial depiction, a representation of a phenomenon by spatial means. In order to map the screen, then, the abstract qualities of perception and the properties, tendencies and capacities that emerge from experience need to be spatialised and used to define territories of invariance at certain scales, along with the boundaries between these territories.

Bernard Cache performs a similar mapping for the city of Lausanne. He uses the critical issues of Lausanne at different points in history to represent the landscape according to a series of folded planes. At a point of history in which the valley is at issue as dividing two growing communities, the vector describing the valley becomes the image of the city's topology. At a point in which the peak is of concern as the siting of the cathedral, the vector describing this peak and the issues surrounding it becomes the image of the city. Cache can, in this way, describe the city as a series of folded planes distributed in a politico-Cartesian space, overlapping in time. He composes a "sort of cubist sculpture" from "the combination of these four basic figures: cone, prism,

74. DeLanda, *Assemblage Theory*, 119.
75. "We need to establish relations of dependency in the way the variables (and parameters) change." DeLanda, *Assemblage Theory*, 119
76. Massumi, *Parables of the Virtual*, 94.
77. DeLanda, *Assemblage Theory*, 115.

dihedral and plane,"[78] each of which express the 'nature' of the city as it was at issue at different times. These vectors are not intended as a succession, but as a structure – a mapping of the possibility of the city. That is to say, Cache's mapping does not just take different features of the city and recompose them into a map. His mapping reconstructs the city behind the city-as-it-is-experienced, overlaying material and geological structures with structures of thought and language. The city emerges from these vectors as a whole, and from the movement between them. The 'nature' of the city lies in a "solution of contiguity between these four geometrical figures," the structure made from the virtual cities of Lausanne, encountered as material and conceptual actualities at different points.[79] Cache's project constructs a space of possibility for the city from how it has been actualised at various times – a map of its possibilities. However, Cache has the distinct benefit of working with a Euclidean space. That is, his vectors are spatially distributed as if located within the city itself in the traditional form of the map; with height corresponding to the y axis, length to the x and depth to the y; so that the vectors that result can be superposed within these planes. Such an option is not available for the screen.[80]

Space and sound

One can, for example, determine the rate at which the curvature of a space changes at a given point and use this instantaneous rate of change to identify it ... When we do this space ceases to be a set of coordinate addresses and becomes a field of rapidities and slownesses, the rapidity or slowness with which curvature varies at each point.

Manuel DeLanda[81]

Calculus shows spaces as rates of change, as movements rather than locations. *Some Assembly* uses sound and time as a measure of space.

The ultrasonic distance detector comprises an ultrasonic transmitter, receiver, and a circuit. It sends out pulses of sound at 40Hz and waits to hear a reflection. This reflection is returned as a pulse width band heard on the receiver, the width of which corresponds to the time taken to hear the signal. Time is then converted

> to a lineal distance, by multiplying it by the velocity of sound (in cm/microsecond, negating time) and dividing it in two (to measure just there and not back).
>
> Sound becomes time becomes distance. This procedure is accurate between distances of 2cm (a 150us pulse) and about 4m (a 25ms pulse). At more than about 4m, the receiver times out and stops listening, returning the maximum value of 38ms. At less than 2cm of this range, the return signal comes too quickly for the receiver to hear it, and the receiver times out as if nothing were received.
>
> In the sound space of *Some Assembly*, extreme closeness sounds like extreme farness. High impact collisions and the persistent ramming of barriers may result. But in face-to-face situations, other bots sound a lot closer than they are. The distance calculated from another bot's transmitter is halved even though the distance between them is not. Closeness is not necessarily nearness. Bots shy away from approaching each other face-to-face – stopping and looking around to see if there's other ways through. Banging their heads against the wall seems perfectly acceptable, though.

To perform such a mapping operation for the screen, the first thing that needs to be done is to set axes, the parameters of the map. These parameters will "stand for the properties in the immediate environment"[82] onto which screenic variables (somewhat counterintuitively, the invariants of the screen, which become variables in their multiple possibilities) can be mapped. But unlike Cache's topographic topology, the space of the screen's possibility has no intrinsic spatial structure. DeLanda discusses this problem, saying that such a space can have order imposed on it "as long as this is justified by reference to the mechanism… and

78. Bernard Cache, *Earth Moves: The Furnishing of Territories,* trans. Anne Boyman, ed. Michael Speaks (Cambridge: MIT Press, 1998), 11.
79. Cache claims that the identity of the city lies in the structure between these vectors: "one must learn to read a space of 'transistance' that allows us to pass from one vector to another. Throughout the ages, the identity of Lausanne has not so much changed, or repeated itself, as it has lived with itself under the determination of these four sorts of vectors" Cache, *Earth Moves*, 14.
80. Although the Euclidean space in which Cache is working does provide advantages, it also makes the resultant map less abstract and more signifying, which somewhat interferes with the aims of the diagram.
81. DeLanda, *Philosophy and Simulation*, 18.
82. DeLanda, *Assemblage Theory*, 119.

as long as it serves to reveal the structure of possibility space."[83] He performs this ordering based on minimal difference, arranging spaces of homogeniety and heterogeniety. DeLanda uses the example of an artificial intelligence (AI) trained to recognise and gender human faces to illustrate this point. He states that the AI, when presented with images of people and asked to classify whether they were male or female, used an unexpected method to perform the task. Rather than categorisating the whole image as a spatial distribution of points, the AI approached the task as an exercise in mapping similarity. In this way, the AI arranged images into a space of similarity and difference, and tested new images against different regions.[84]

The number of ways in which 'similarity' is measured determines the dimensionality of the possibility space as imaged. Each of these ways of measuring similarity corresponds to a parameter that defines the space. Finding these parameters means understanding where the boundaries of the screen lie at different scales, and about what movements might provoke a shift across these boundaries. This thesis, as it concerns the screen, has already begun to identify some of these transitions, which I will now reframe here as parameters.

Order

Chapter two found the screen to be a particular point of tension between materiality and agency, and found spatial ordering to be implicated within this tension, both as an action of the screen itself and as an action of the pixels from which the screen emerged. This sense of order was found once its limit was passed. *Moubie*, particularly, implicated ordering as a screenic process by interrupting human directedness in ordering space. But *Moubie* also presented not as a screen himself, but as a screen-bearing object. The 'screen' portion of *Moubie* was ordered in a way that the rest of him was not, and this provoked a more localised territorialisation of this portion of *Moubie* as a screen. The screen's ability to order space is dependent on its own material order, as shown in its directedness as an array of its pixels or repetition of apertures. The ordering at this scale – before the screen emerges as a whole – affects the properties, capacities and tendencies of the screen

as it emerges. Order is taken as an appropriate starting point to define the parameters of the screen's space of possibility.

In his discussion of state space in phase transition diagrams, DeLanda introduces the idea of the gradient as a measure of order. Through the example of mixing two separate bodies of water, held at different temperatures. The temperature gradient that is established the moment two separate bodies of water begin to interact is highly ordered, according to DeLanda, as the whole is present as two sets of molecules with vastly different energies. That is, there is a diversity of properties distributed unevenly across the whole.[85]

The tendency of this whole to move toward temperature equilibrium is manifested as the ordered system moves toward disorder. Considering this process in the terms of assemblage, the two separate bodies of water exist as strata – stable entities at equilibrium. The moment they are mixed represents a deterritorialisation, an unsorting of a stable entity to form an assemblage. From this new whole emerges a new tendency: to move toward equilibrium. The body of water that is produced after this tendency has been manifested represents a new stratum. Order, in this example, is a measure of heterogeneity of physical properties across a gradient.

The concept of a heterogeneous distribution presents a view of order somewhat counterintuitive to the experience of the screen. The ordering

83. DeLanda, *Assemblage Theory*, 50. In his example of genetic mutation, DeLanda identifies a problem with mapping abstract things in that the spatiality of the map has to be applied. He states: "unlike state space that is a continuous topological space with well-defined spatial connectivity the space of possible rules is a *discrete combinatorial space* possessing no intrinsic spatial structure: all the possible rules simply lie next to each other." DeLanda, *Philosophy and Simulation*, 29. This applied structure cannot be arbitrary, however, it needs to make apparent the regions of persistence and change. The applied structure is based on what needs to be known about the thing.

84. "The secret is the mapping relations of similarity into relations of proximity… That is, objects that resemble each other become neighbouring points in the internal possibility space, and vice versa, objects with a higher degree of dissimilarity (faces and non-faces) end up as points that are far away from each other in the space of possible activation patterns" DeLanda, *Philosophy and Simulation*, 98.

85. "At the start of the process the existence of a temperature difference means that the water molecules are distributed with a high degree of order, that is, they are neatly sorted out into two parts, one hot and the other cold. At the end of the process the entire population is uniformly warm and this order has disappeared" DeLanda, *Philosophy and Simulation*, 8.

of pixels, as it was addressed in chapter two, is a spatial ordering that relies on homogeneity. The screen as a pixel array emerges because the capacities of pixels are distributed evenly across a spatial array. It relies on the regularity of the spatial interval between pixels, and on their spatial equivalence as nodes. This difference can be accounted for by involving the human in the screen assemblage as an observer.

The process of territorialisation is itself an ordering process, one that divides up heterogeneous mixtures into homogeneous wholes. Massumi expresses this relation in terms of movement and stasis. In his example of calculating the trajectory of an arrow, he notes the operation of inserting points along the arrow's flight path as a retrospective ordering that allows the arrow to occupy space as it moves. Such retrospective ordering is an easier operation the higher the level of perceptual homology.[86] Ordering the trajectory of the arrow is easier if it takes a single, predictable flight path. The predictability of the flight path aids in whole of the 'flying arrow' emerging in perception. Likewise, the whole of the screen emerges more easily if its constitutive parts can be ordered in a predictable fashion. Although pixels that are distributed unevenly show more order as a system in themselves, they are less amenable to the ordering of reflexive perception.

The grid

[T]he line of the Outside is not a fixed limit but 'a moving matter' ... Beneath this line there is sheltered a strategic zone ... and beneath that again the strata or collected archives of knowledge, where habit, opinion and cliche come to be sedimented.

Hélène Frichot[87]

The orchestrated effect of the screen begins to decay as the bots introduce new behaviours and begin to communicate. The order that I can impose on the system through perception is altered as the system begins to order itself.

The grid, a homogenous spatial ordering, helps me recognise the screen. The screen emerges easily when the bots are in a regular array, the points of light are

distributed evenly over a field. But this emergent effect is overpowered by the one below it. The two layers of the screen – the television screen at the base of the field and the screen that emerges across the bots – carry the same information. But the density of the information below the bots is much richer. If the second emergence is seen without its environmental trigger, a screen emerges for me. If I see both in succession, the second emergence becomes less screen-like.

There is, I think, a stronger moment of screening. Just after the bots have begun to turn out of the array, the effect that emerges across the bots begins to hold new information. This screen tells me something that the screen below it doesn't. It tells me about how the bots have moved and where they've gone.

At this point, the bots are still responding directly to their environment at regular intervals. They're still relatively synchronised, their behaviours still strictly timed, but their movements alter spatially as they express tendencies peculiar to their materiality. One bot might have a centre of gravity slightly to the right, causing it to favour one direction over another. Another bot might have a less effective battery, meaning it doesn't move as far as another.

As the bots begin to order themselves spatially on the individual level, while remaining temporally synchronised in the way they work together, they communicate their own difference using a medium-in-common. They are somewhere between ordered and disordered, between homogenous and chaotic. They allow me to order them as they order themselves.

86. Massumi states that "retrospective ordering enables precise operations to be inserted along the way, in anticipation of a repetition of the movement – the possibility that it will come again" Massumi, *Parables of the Virtual*, 10.

87. Frichot discusses here Deleuze's diagram of the fold, made in his volume on Foucault, which draws a relation between the 'Outside', stratification and the subject. Hélène Frichot, "Deleuze and the Story of the Superfold" in *Deleuze and Architecture*, ed. Hélène Frichot and Stephen Loo (Edinburgh: Edinburgh University Press, 2013), 86.

Density

When considering the interaction of the ordering of the screen and the ordering of human perception, another parameter comes to light: communication. To compare the example of the screen with DeLanda's example of water equilibrium, the separate containers of water with the property of a particular temperature value might be replaced with a group of light emitting diodes, each with the property of a particular colour value. If these LEDs are mixed together, they will form a difference of colour across the whole. However, as it stands, no new tendencies spontaneously emerge from this 'whole'. The whole is a collection, not an assemblage. A screen is unlikely to emerge from this scenario, because the de-territorialisating move of mixing heterogenous components cannot be resolved by the system as it stands. In order for an assemblage to arise from this collection, the LEDs will need to be networked so that they can communicate. The water molecules of DeLanda's example do this spontaneously by exercising their capacity to collide, thereby transfering energy. Energy transfer between LEDs, however, requires additional components: a source of channelling energy into the system, a manner of distributing this energy across the system, and a means of addressing each LED as part of a whole. Once this communication is established, new capacities may emerge across the array – a capacity to react simultaneously, for example, which requires a similarity of speed and distance amongst the components. This capacity can then provoke a re-territorialisation of the LED array as a screen.

The most 'assemblage-like' moment of the screen of this example is when communication is established across the LEDs. The same may be said for the screen of the lattice, where the establishment of communication between apertures occurs when a relation can be established between them in terms of their repetition and distribution across a surface. This communication allows the differences of the LEDs (their specific colour values) to be expressed in a way that allows a re-territorialisation in perception to a different scale of entity: a screen.

If the assemblage, and the reterritorialisation it provokes, can only be created through additional mechanisms, then the possibility space of the screen will need additional axes to account for the emergent effects. Along with order as a measure of the heterogeneity of the actual properties of the system, it will need a measure of communication across the assemblage.

The space of communication

Communication forms its own space. Radio Frequency units transmit and receive data across the bots, allowing each individual to be identifiable within the collective. Each bot has a name (int myID = 6;) and a place to recognise the name of another (int oppID = 0;). Bots can introduce themselves on meeting by transferring a data structure involving their names over a 433 MHz radio frequency, using the other to make decisions about their actions.

If I, bot with myID == 6; meet you, bot with myID == 1; I'll tell you my name. If you hear me, you'll tell me yours. We can compare our names to make determinations about actions.

```
void RFpingpong(){
  mydata.pingID = myID;              //I am me
  mydata.pongID = 0;                 //I'm not talking to anyone in particular
  oppID = 0;                         //and don't remember anyone's name
  for (j = 0; j < 5; j++){           //five times in a row, I will
    vw_rx_stop();                    // stop listening
    ET.sendData();                   // start talking
    delay(15);
    vw_rx_start();                   // then start listening again
    delay(500);
    if (ET.receiveData()){           //if I hear something
      if (mydata.pingID == myID){    //and it's a reply for me
        oppID = mydata.pongID;       //I'll hear your name and remember it
        break;
    }
```

```
    else if (mydata.pongID == 0 ){    //if I hear something that's not a reply for
                                      me, but you haven't identified anyone else
      oppID = mydata.pingID;          //I'll remember your name
      mydata.pongID = myID;           //and ask you to remember mine
      ET.sendData();
      delay(100);
      break;
    }
  }
}
```

If we get this far and the loop hasn't broken, then I'm probably telling my name to something that can't speak. You're probably a wall. But if you're not a wall, we can decide which of us will move out of the other's way.

```
if (oppID < myID){          //If you're higher in the hierarchy than me
  evade();                  //I'll move out of the way
  }
else {
  delay (500);              //If not, I'll wait for you to move.
  }
```

I can't listen for you at the same time as speaking, or else all I'll hear is myself. The RF receiver needs to be shut off in order to transmit information. In fact, I can't do anything else while listening. The RF receiver is power intensive, and running other processes at the same time interferes with the signal. I can only listen for so long before needing to get back to my other activities, to contributing to the whole.

We all work together, but we are each individually identifiable within the social space we have created through individual acts of communication. Because we can only listen to each other for so long, I might not hear you when you speak – perhaps I'm trying to negotiate a corner of the field at the time. Or worse, perhaps you're talking into a wall, or into another bot. Your message will be blocked by the materiality of the environment.

The space of communication is interrupted by the relative positions of bots in the field. A stronger spatial order is linked to stronger communicative connectivity. When the same RF mechanism is used to communicate trigger events, alerting the bots to read the environment and display their colours, spatial ordering and communicative connectivity translate into the efficacy with which the screen appears. As space becomes less ordered, communicative connectivity decreases and fewer bots respond to the call to display. The screen does not appear.

In terms of the emergent whole, the communication between pixels and apertures is measured as a degree of connectivity. It is the connectivity between pixels, their ability to align their colour values in meaningful ways, that allows the screen to emerge as a whole. DeLanda discusses a degree of connectivity in regards to a community's density and the capacities that emerge from it.[88] In this discussion, density is not so much a spatial connectivity as a connectivity of communication – although the two are not necessarily separate. For a community of people, tighter communication means a higher level of consistency in ethical codes. Density, in this manner, can be seen as a measure of homogenisation. The community is more effective at enforcing norms if it is more homogenous in its intent towards defining these norms, and towards enacting appropriate enforcement techniques. Such a community is more strongly stratified, it represents a solidified whole. However, this homogeneity does not erase the differences between each individual. It exists alongside this individuality at another scale.

In a similar way, the density of a collection of pixels or apertures is often described spatially. The capacities of steel cladding screens are described in terms of aperture size and percentage of open space. The resolution of Liquid Crystal Displays is determined by how many pixels are present across a plane measured in Cartesian space. Although described in terms of these properties – open space, dots-per-inch or as the absolute size of the array – these resolutions are important because they describe how much information the screen can hold as a whole,

88. "The property of density, and the capacity to store reputations and enforce norms, are non-reducible properties and capacities of the entire community, but neither involves thinking of it as a seamless totality in which the personal identity of the members is created by their relations" DeLanda, *Assemblage Theory*, 11.

across these individual pixels and apertures. Screen resolution is more a measure of information density than spatial density – of the capacity of the whole rather than the physical distribution of its components. Density, then, is a measure of the connectivity of the individuals, the homogeneity of purpose or intent in contributing to the whole.

Individuation and orchestration

Arborescent systems are hierarchical systems ... In the corresponding models, an element only receives information from a higher unit ... This is evident in current problems in information and computer science, which still cling to the oldest modes of thought in that they grant all power to a memory or central organ.

Gilles Deleuze and Felix Guattari[89]

There are instead always a swarm of vitalities at play. The task becomes to identify the contours of the swarm and the kind of relations that obtain between its bits.

Jane Bennett[90]

Is the screen an orchestrated effect? Does it have to be processed from outside, or can it emerge from an inside?

Most examples of screens rely on a centralised form of processing. Images are taken, digitalised, laid into an array in an external processing unit. This array is then pushed to a display, where each pixel is addressed by its location and an instruction. In a television this is done through broadcast. In Rozin's mechanical mirrors, by computer and wire. Pixels don't interact with one another, they interact with the processor, the information mastermind. Information is shipped as a layer and presents as a layer, settling on the pixels as separate from them. Non-digitised screens also seem to work this way. The information on the other side of the lattice does not emerge from the apertures, even if the 'other side' is a function of the lattice as a whole. The information of cinema is layered on to film, which orchestrates the pattern as it falls on the wall.

If the whole of the screen could come from inside the pixels rather than happening to them from elsewhere, the information it could carry might be different. The screen could talk about itself, about the differences of the pixels as they went about their business. Perhaps the image could change as pixels moved from one

end of the screen to the other. Perhaps the image could represent how well pixels talk to each other, or how well they're listening. If this were the case, the image that emerged would be a screen that was about a screen. The screen would be a whole comprised of an assembly of individuals, each acting for itself but together generating an effect that belonged properly to the whole.

Speed

Connectivity has a particularly temporal aspect when it comes to the screen. Pixels and apertures that act together do so in time, in synchronicity. Speed plays a role across screen forms as well as within them, defining differences in capacities and tendencies. Of all the properties that define an assemblage at a particular scale, DeLanda holds that speed "can be singled out as one of the most significant," as it is an intensive quality which causes qualitative change at critical points, resulting in qualitatively different capacities.[91] Massumi also highlights the role of speed in how things appear, stating that the thing is "when it isn't doing" – that is, it is only when a thing is in a state of arrest that it can be seen as a thing, rather than a movement. Quick things, for Massumi, cannot be actualised, they remain in the realm of the virtual: "Something that happens too quickly to have happened, actually, is virtual."[92] The actual is stopped, whereas the virtual is in flux. Movement cannot result in 'things' without being slowed down, or artificially stopped as a "back-formation" of movement. In this way, stasis becomes "a special case of reiterative movement: that allowing recognition."[93] Cessation actualises the thing from its movement, it introduces a temporal persistence to materiality.

89. Deleuze and Guattari, *A Thousand Plateaus*, 16.
90. Bennett, *Vibrant Matter,* 11-12.
91. DeLanda, *Assemblage Theory*, 75.
92. Massumi, *Parables of the Virtual*, 6; 30.
93. Massumi, *Parables of the Virtual*, 66. DeLanda expresses a similar idea of stasis as a 'backformation', saying that all things exercise a speed, even the things we take for granted as concrete and foundational. He writes: "if we consider that the oceanic crust on which the continents are embedded is constantly being created and destroyed (by solidification and remelting)… the rocks and mountains that define the most stable and durable traits of our reality would merely represent a local slowing down of this flowing reality. It is almost as if every part of the mineral world could be defined simply by specifying its chemical composition and speed of flow." Manuel DeLanda, *A Thousand Years of Nonlinear History* (Cambridge: MIT Press, 1997), 258. In light of Massumi's discussion of speed; 'stopping' things can be seen as a perceptual process, an assumption of rest where other contexts might imply a slow movement.

Just as speed has a role in the recognition of material things, Bennett notes the role of speed in the understanding of action and agency, saying that "in the long and slow time of evolution… mineral material appears as the mover and shaker, the active power." At this long time-scale, quick actions seem inconsequential; they are not sustained long enough to have effect. The material is actual; it is slow and fixed, proceeding "at a speed or level below the threshold of human discernment."[94] Agency is virtual, fast and moving. Considered in terms of the cinema or television, a difference in speed could account for the split between the frame or wall in its slowness and the fastness of the image it displays, as well as the association of this image with an effect over the slower materiality of the thing.

Inverted pace

A television, cinema, a lattice… the object in these cases moves slowly, the space it supports moves quickly. The space is matched to my pace, my ordering. It takes my attention as a try to keep up with it. The object doesn't ask for such attention, it's unlikely to change while I'm looking.

Some Assembly works in a similar way. Its pixels are large and cumbersome, sitting still in a field while images move above and beneath them. As the bots begin to look around, they start to express a speed. One by one they join in to a collective movement, a pace that arises between them in-time but expresses a movement out-of-time – when one bot is looking left his neighbour may be looking right, but the speed and sequencing of the movement is similar. The images remain above and below, but an interstitial layer of movement arises, segregated in time. Here I see the bots looking around but no image, here I see the image appearing and the bots are still. The speed of the two is similar.

The segregation between these phases starts to decay. One bot begins to move as the image is presented, then another, then another, until a whole group of bots seem to be ignoring the image altogether. Their movements, now, are quicker, more forceful, more varied. The speeds with which they move into one another and away from one another seem greater than the speed of the image. The image is less reliable. Fewer and fewer pixels respond, and the timing of their response is varied. The image is now large and still, the bots quick and responsive.

The moving image becomes an image-bot, becomes an environment-response, becomes a social interaction as the speed and differentiation of the bots increases. The pace of the system has been inverted. The pixels are pace-matched to my pace, the image is no longer responsive.

For pixels to act together, they must show a similarity in speed. From this similarity emerges the whole of the screen. The screen can be identified, in this case, because the response of the group of pixels in relation to its environmental context shows a similarity of rapidness. Likewise, the analytical split between the object and space of the screen could be described as a difference of speed. A space and a screen are seen as separate entities here because they work at different speeds in relation to their environmental context. Speed, as a property, impacts the scale at which a whole can be found in relation to its context.

Fig 46. *Lagging Behind.* [Video, 00:18].

Lagging

The image appears below and the bots respond. Some stop moving, others don't. One lights up, then another, then another. The image below disappears. As the first bot switches off his light, a new bot, over in the corner, lights up. The others switch off, begin moving again, but the bot in the corner remains lit until his time is up.

The image was gone, how did it decide what colour to display? How did it respond so laggingly?

94. Bennett, *Vibrant Matter*, 11; 18.

Parameters of screenic space

Three parameters thereby present themselves as appropriate axial conditions given the explorations undertaken in this project. The order of the screen, measured as a degree of material and behavioural difference across individuals in the population; the density of the screen, measured as a degree of connectivity across its components; and the speed of the screen, measured as its rapidness of response to environmental change, including informational change.

These parameters represent the degrees of freedom of the screen's possibility space, the regions of similarity and difference that can arise in screening. Each variable can then be located within this space as a combination of values as "an instantaneous state of the process being modelled."[95] From these parameters and variables, the individual instances of the screen within their relevant context and the relations between changes in context and changes in state, the field of possibility of the screen emerges.

Another screen

In site writing there are two analytical objects: the artwork that lies between the critic and the artist, and the critical essay or text, which is located between critic and reader.

Jane Rendell[96]

Some Assembly is a performance, a group of material things, a written response, an analytical paradigm, a series of photographs and a series of videos. Each of these things is a communication. Each lies between me, who has a position to communicate, and you, who is being communicated with.

Whether any of these are representations of more originary events is a matter of opinion. Do the photographs re-present moments of the performance (bot – photograph – reader)? Does this paragraph interpret the way the bots they behave (bot – situated writing – reader)? Have other paragraphs communicated the design intention behind the bots (designer – situated writing – reader)? Do the bots re-present moments in the analytical paradigm (analysis – bot – reader)?

The stacking of these modes of communication is, for the most part, neither here nor there. Or, at least, they can be taken together in any order to produce meaning. But there is one mode that becomes a bit more problematic – using another screen.

Some Assembly uses video to introduce new speeds that can't be reached with the materiality of the bots. There are two scales of pace at play – the consistent pace of the material, and the variable pace of the video. Frames of video, recorded at the time of the material, were cut up, sped up, assigned new timeframes. Intervening frames were deleted until a 'pure' condition is met, one in which a field of lights move across a surface at 25 frames *per se*cond. This pure condition was shown on another screen – the screen the video was played on.

But, in the move from one to another, the pace of the material is also a part of the video. The changing conditions of speed, order and density – responsible for the decay of the screen into a field of bots – require for communication a screen that will *continue* to be a screen. The non-decaying screen communicates the decay of the screenic condition.

The screen in *Some Assembly* is both an object of analysis and a mode of communication. This analysis can't happen outside the screen. The screen is included once, below the bots as an environmental trigger; twice, in the condition that emerges from the bots; and thrice in the screen above, where the video composition is watched. Between the first and third screens is an interstitial layer of non-human activity, which sometimes matches these screenic conditions, sometimes keeps them separate, and sometimes twists one into the other.

Fig 47. *The Second Screen.*

95. The parameters define "the dimensions of the possibility space," "the relevant ways of changing for an assemblage, that is, its degrees of freedom." DeLanda, *Philosophy and Simulation*, 189; 19.

96. Jane Rendell, *Site Writing: The Architecture of Art Criticism* (London: IB Tauris, 2006), 12.

The location of the thresholds between these instances can be found by watching the transitions as they happen. This event of transition is incomplete; it is the "image of the movement of the actual's appearing… it is necessarily analogic, incomplete at any and every particular conjunction."[97] Critical points of transition are the movements between fixed relata. If the moment of shifting is not observed, these relata might look unconnected. If the movement between relata is not seen, it is easy to assume these relata are fixed and static, rather than being caught within a shifting relational structure.

When does it stop being a screen?

Where is the critical transition between the screen and the pixel?

Is it when the bots start looking around from their places? Does that first expression of speed at the scale of the pixel interrupt the screen?

Is it when the first bot catches his eyestalks on the bot in front of him, forcing a rotation until he falls out of array? Does that first moment of disorder interrupt the screen?

Is it when the bots begin to back out of the grid? Does that change in density interrupt the screen?

Is it when the bots turn to face each other and navigate their environments, moving toward and away from each other at different times rather than in unison? Is it when the other behaviours of the bots begin to interrupt their light display? When they become more concerned with their responses amongst themselves? When they become stuck in corners and forget to listen for the trigger? When they fall out of time with their responses, lighting when the others are dark or turning a blind eye to the colours?

Or are the pixel and the screen always present as possibilities? Is the system actualised in different ways as it moves through critical transitions of speed, density and order?

PACE: ONTOLOGY AND THE SCREEN IN RELATIONALITY

When discussing issues of perceptual change and the space of possibility, the temporality of perception becomes particularly apparent. Deleuze and Guattari maintain that assemblages are defined by their speeds. Using the analogy of the wolfpack, they write that "the wolf, wolves, are intensities, speeds, temperatures, non-decomposable variable distances," and it is in these speeds that they form an assemblage.[98] The heterogenous individuals of the wolves, each with their own speed and intensity, assemble into a pack which is characterised by the confluence of these individual speeds and intensities, as well as their spatial distribution.

Whether the wolves are perceived as a group of wolves or a pack; whether the television is seen as a group of pixels or a furniture piece or an image or a 'screen'; is a matter of how the assemblage is territorialised. At one scale of the screen, this is an assemblage between the individual pixels which make up the whole. But at another, it is between a person and the pixels. At yet another, it is between *this* person and *this* screen. Each of these occurs within a different context.

When considering territorialisation as a perceptual process, the critical points of transition between any of these contexts are always critical points in the assemblage of which a perceiving person is a part. Such an understanding of perception implies that humans have, in their directedness, a certain speed and order; a matter-movement that belongs to them. Heidegger shows an aversion to changes in distance and speed in his opening to "The Thing." His disagreement with the television is based in it interfering with human perceptual methods by rendering all distance equal.[99] The same could be said of televisions'

97. DeLanda, *Philosophy and Simulation*, 19.
98. Deleuze and Guattari, *A Thousand Plateaus*, 32.
99. Heidegger writes: "Man puts the longest distances behind him in the shortest time. He puts the greatest distances behind himself and thus puts everything before himself at the shortest range…What is least remote from us in point of distance, by virtue of its picture on film… can remain far from us." Martin Heidegger, "The Thing" in *Poetry, Language and Thought*, trans. Albert Hofstadter (New York: Harper and Row, 1971), 163.

actions on time. The idea of 'liveness'[100] holds that television has the ability to present things that are temporally distant as just now happening, similarly to its transposition of the spatially distant to the proximal.

The relational structure of the screen, though, involves more than speed as a measure of distance in time. It also involves ordering and connectivity of constitutive parts from which the whole emerges; a sense of sameness that repeats across a diverse, heterogeneous collection of individual pixels or apertures. The synchronicity with which pixels react to their context is distributed across an ordered array of difference in material properties. The screen emerges from perception as a combination of order, density and speed. These parameters allow screens to appear as (and at) a pace. The screen results from a distribution of timing over space rather than solely a rate at which distance is covered.

A person has a certain pace within an assemblage too, one related to their directedness and context. Just as the pack is characterised by the speeds and spaces of its wolves, so too might the assemblage between a person and a television set be characterised by their similarities and differences of pace. Put more plainly, the pace at which a person approaches the world and the pace at which a particular screen occurs are different. This difference in pace affects how that assemblage (the interaction or engagement between person and screen) occurs. The television—as—space is found in perception at a different pace to the television—as—object. The pixels work at another pace again. The consistencies between these speeds may affect how easily a person can territorialise and actualise things from an event, which in turn affects the relata drawn from the engagement. Pace matching in the screen assemblage might influence what arises and what does not – how easily a person as an individual can interact with any particular scale of screenic whole – as a pixel, as an object, or as an image.

The image is, in the case of the screen, perhaps the most suited to the pace of human directedness, and so the more likely territorialisation to

be performed and the more likely relatum to surface. The voltage gates by which a pixel receives a signal open and close at a pace too fast to be properly bounded by human perception. They remain virtual – part of the possibility space of the LCD, but not actualised in experiencing the screen. The plastic which bounds these pixels as a frame, and the plastic and metal from which the pixels are themselves made, are too slow to be of interest. They are unlikely to change during interaction. The slowness of the plastic is revealed as a lack of agency when compared to the fast pace of space generated by the screen, and the effectual changes in the space behind the screen are what hold interest. Just as Bennett's geological context rendered the small, quick actions of humans ineffectual; the context of human perception renders the slow changes of steel or plastic ineffectual. However, the increased speed with which the screenic space – its image – is found does not imply that this is the more important part of the screen; nor does it mean it is primary to pixels or apertures that project this image, nor the frame that surrounds it. As Deleuze and Guattari state in their discussion of the body as an assemblage, the speed of strata are not connected to their intensity.[101]

The slowness of the material is what is responsible for the screen-as-object's constancy, its persistence of meaning. The persistence of the screen object is in its "ratio between perceptual variations: the ratio between habit (pattern of reaction) and the sea of chaos in which it swims."[102] What is important in the relational structure of the screen is to note the connectedness of these different speeds (actualised as different 'things') and mark how they can be turned one into another – in other words, to map their possibilities and transitions. The screen—

100. Anna McCarthy writes of 'liveness' as an ideology that allows the translation of "perceived temporal simultaneity" into spatial collapse. However, she maintains that 'liveness' is not an ontological condition of the television; that it doesn't determine screen experience. Rather, it is the "temporal ideology" of television that allows televisual spaces to be constructed. Anna McCarthy, "From Screen to Site: Television's Material Culture, and Its Place," *October* 98 (Fall 2001): 98.

101. "It becomes apparent that the slowest of movements, or the last to occur or arrive, is not the least intense. And the fastest may already have converged with it, connected with it, in the disequilibrium of a nonsynchronic development of strata that have different speeds and lack a sequence of stages but are nevertheless simultaneous." Deleuze and Guattari, *A Thousand Plateaus*, 172.

102. Massumi, *Parables of the Virtual*, 150.

as—object and screen—as—space are not parts of the screen able to be added back together again,[103] but are different lines drawn around the same phenomena – an event that occurs with a certain pace. The ontology of the screen as a relational structure lies in the variations of this event, the different ways in which the 'screen', as well as a screen, or a group of pixels or apertures, can be actualised.

ASSUMPTIONS AND CONCLUSIONS

This chapter addressed the screen as a relational structure. It began by finding a mechanism by which to flatten the hierarchies between the relata and relations present in previous chapters, so that these could be considered as part of an iterative, immanent process. This allowed the persistence of meaning of the term 'screen' to lie with a diverse population of screen experiences, rather than with an unchanging essential characteristic. The screen as a whole could then be seen as emerging at different scales – as a population, as an individual experience, as a collection of pixels.

The emergences of the screens were linked to structures of perception, particularly to the process of territorialisation as a form of drawing boundaries around experiences to form 'things'. This was approached as a way of homogenising regions of an experience so their similarities could be expressed. This process was shown to occur at different scales at different times, so that different relata were found within experience. The screen, then, was found between these differences – across its relata rather than in them. This represented the relational structure of the screen, its field of possibilities.

This chapter then set up a structure for mapping this field of possibilities, by defining appropriate axes and ways of locating a transition from one relatum (a screen) to another (a group of pixels) along these axes. This transition was used as an example of the kinds of critical transitions that the screen might undergo, and the factors that might be important in these transitions. The resulting map represented a part of the relational structure of the screen. It is noted, however, that there are differences between this relational structure or field of possibility of the screen and what the thing is. As DeLanda comments,

103. Deleuze and Guattari write of the abstract machine of the face: "any approach based on stages in ontogenesis is arbitrary: it is thought that what is fastest is primary, or even serves as a foundation or springboard for what comes next. An approach based on part-objects is even worse; it is the approach of a demented experimenter who flays, slices, and anatomises everything in sight, and then proceeds to sew things randomly back together again. You can make any list of part-objects you want… it's still Frankenstein." Deleuze and Guattari, *A Thousand Plateaus*, 171.

the conceptualisation of a thing is separate from any of its instances.[104] In arguing that the screen exists as a virtuality, a relational structure of nested relata and relations, a difference has been established between any particular screen and the population of the screen as a term. But there is a difference between the thought of the screen – the 'map' as it has been constructed here – and the screen itself.

Massumi's idea of the 'image' of the relational structure was brought up earlier in this chapter as a way of revealing the virtual, but it should be clear that this image does not coincide with the virtual. The relational structure is inaccessible; it cannot be experienced. As Massumi states, the dimension of the emergent "can only be analysed as a continuous but highly differentiated field that is 'out of phase' with formed entities."[105] The virtual cannot be reached, because it cannot be actualised – anything actualised becomes determinate, another stratum at another scale, and this is the way that experience accesses things for people, as a series of determinations. As Deleuze and Guattari put it, "behind each stratum, encased in it, there is always another stratum."[106] Everything that is revealed is actualised, and everything actualised is determinate.

Rather than being a point of access, the image of the relational structure works in a particular way: it takes what is actual and infers a relational possibility from it. It accesses the virtual by networking the actual into a series of relations. The problems of this approach are made clear in Massumi's arrow example, cited earlier in this chapter: if the arrow occupies a point along the path of its flight, it is unable to move to the next. At any point, the arrow is stationary.[107] The flight of the arrow cannot be recovered from the points in which it is actualised, but at the same time, the flight is only accessible as this series of points.

In mapping or imaging the relational structure of the screen, the thing is being reverse-engineered from actual to possible. The things there is experiential evidence of – the things that actually happen – are assumed to be the most probable, and these come to define the structure of the field of possibility. Moreover, the relational structure must be left in order to achieve this: any image is a determination, it fixes in place of something that is in flux. This determining move has been made across

all of the ways of thinking presented in this project, and it is common to many disciplinary paradigms.[108]

In what sense, then, does this relational structure become useful? Primarily, its usefulness relies on the foundational principle of its immanence. As immanent, the relational structure of the screen sits alongside the image or map of the structure that has been made, though at a different scale. The thought of the structure (in this case, the image or map) and the structure itself have a structural overlap – that is, the map of the screen becomes a part of the population of screen's assemblage.[109] This overlap is always incomplete. The axial parameters restrict the space which the map can cover, and the selection of mapped relata sway the critical transitions that can be found. The more these relata are challenged, the more parameters are considered on the map, the richer the image becomes.

The map is a reduction, but one that relies on the same ontological assumption as the thing itself, and so can be superposed with it. Mapping the screen in this way, then, remains a different exercise to finding a screenic essence because it makes an effort to refer back to what it does not know and does not show. The foundation of the relational structure of the screen is what is not found on the map.

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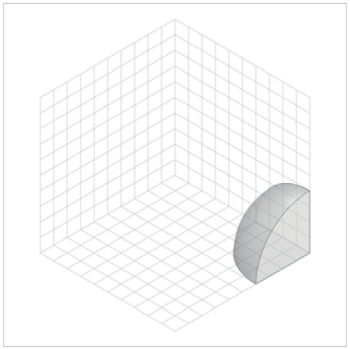
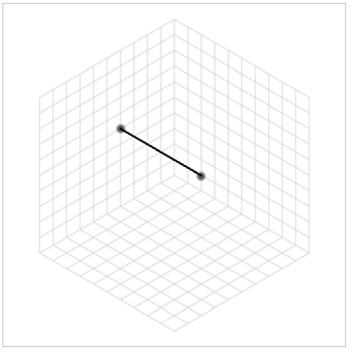
104. "It is important to keep the concept [of the assemblage], with its material and expressive variables and its territorialisation and coding parameters, apart from actual cases, with their material and expressive components, and the articulatory processes that select, sort out, link and stabilise those components. The distinction… forces us to confront the question of the cognitive relation between the concept and the actual cases" DeLanda, *Assemblage Theory*, 138.
105. Massumi, *Parables of the Virtual*, 34.
106. Deleuze and Guattari, *A Thousand Plateaus*, 159.
107. Massumi explains that "the problem is that between one point on a line and the next, there is an infinity of intervening points. If the arrow occupies a first point along its path, it will never reach the next – unless it occupies each of the infinity of points between ... The arrow gets swallowed up in the transitional infinity" Massumi, *Parables of the Virtual*, 6.
108. Massumi links this way of finding meaning as common to the major paradigms of this thesis. He writes: "taking pregiven terms, extracting a permutational system of implicit positionings from their form, projecting that system to a metaphysical point before the givenness of the terms, and developing the projection as a generative *a priori* mapping – these moves are common, in varying ways, to phenomenological, structuralist and many poststructuralist approaches." Massumi, *Parables of the Virtual*, 70.
109. DeLanda writes: "a mathematical model can capture the behaviour of a material process because the space of possible solutions overlaps the possibility space associated with the material process" DeLanda, *Philosophy and Simulation*, 19.

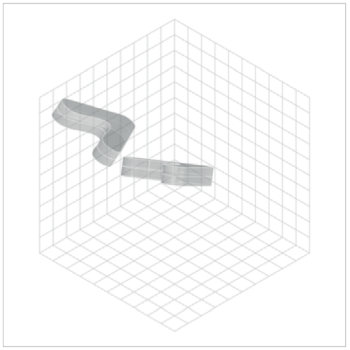
THE SCREEN'S IMAGE



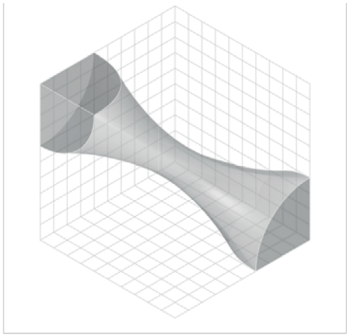
A HISTORICAL MATERIAL PATH



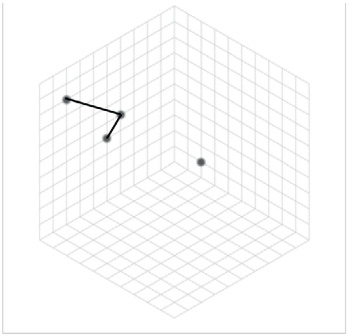
PRODUCING ‘REAL’ SPACE



A ZONE OF FRAMING



A SCREEN ZONE



PRODUCING ‘VIRTUAL’ SPACE

A ZONE OF SUTURING

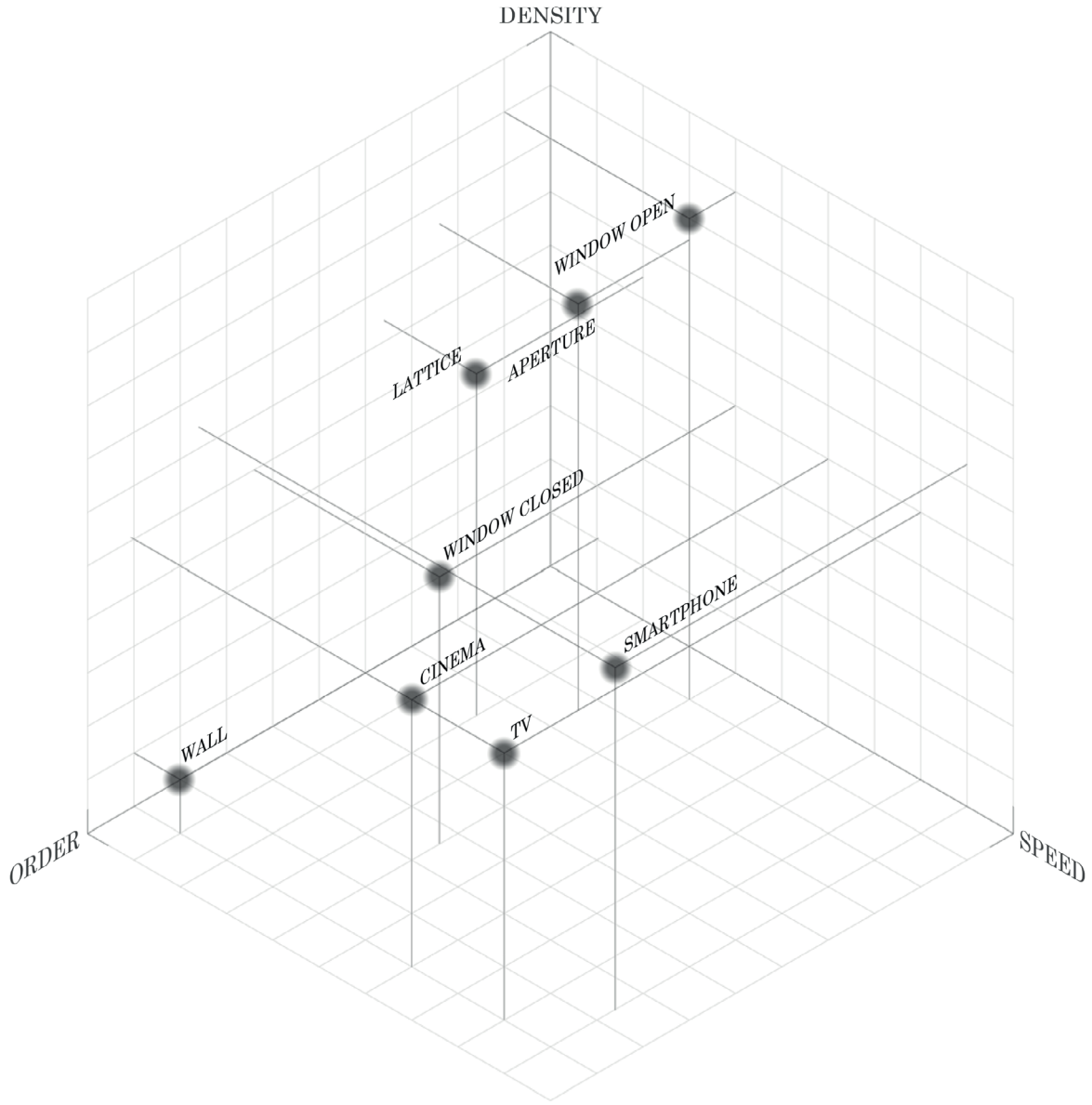
A ZONE OF SITING

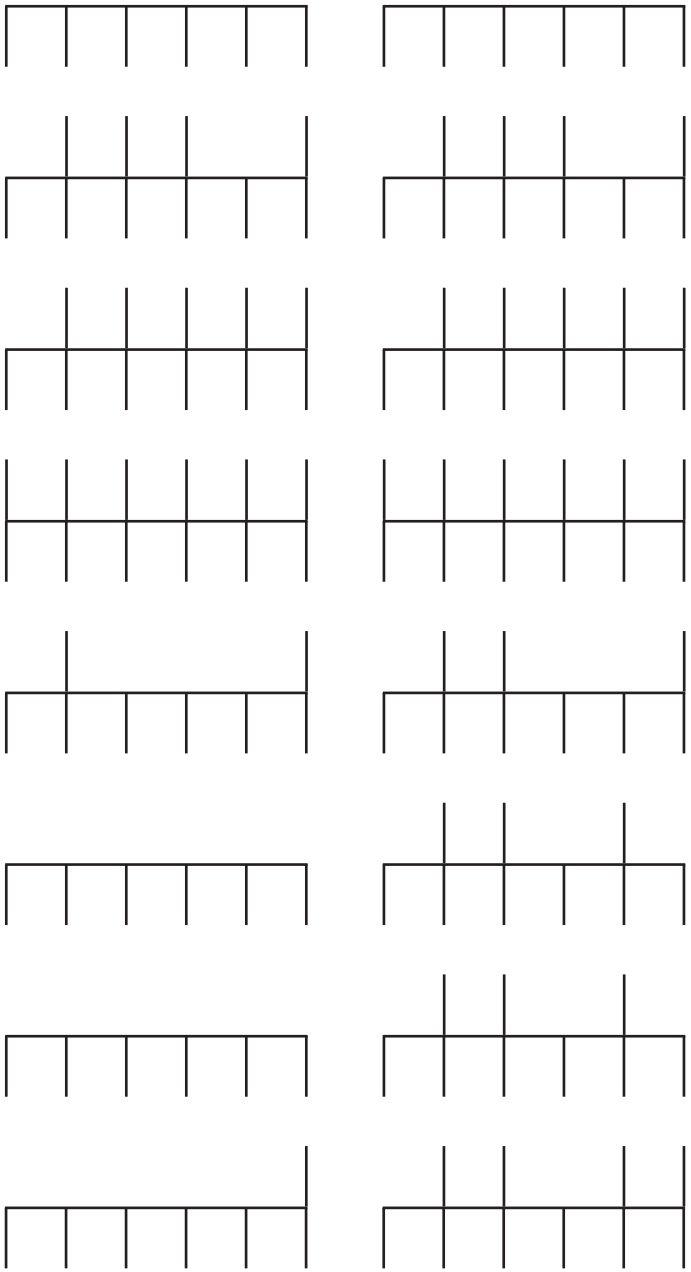
ORDER The screen stopping space

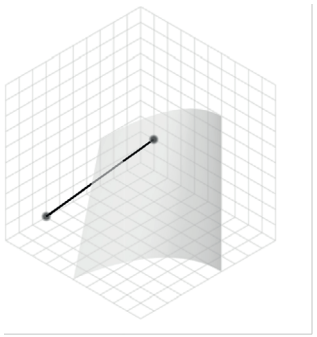
DENSITY The screen reproducing space

SPEED The working speed of spatial information

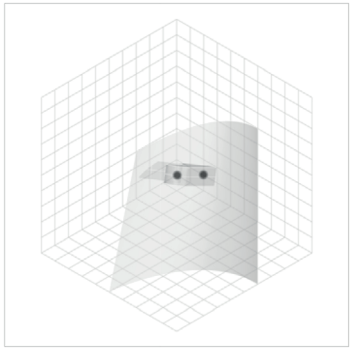
A SCREEN THAT ORDERS



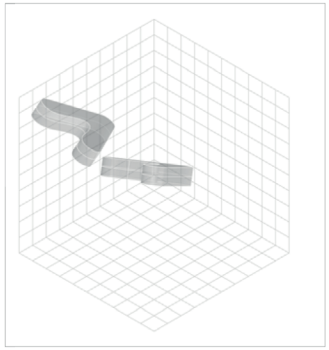

ORDER
DENSITY



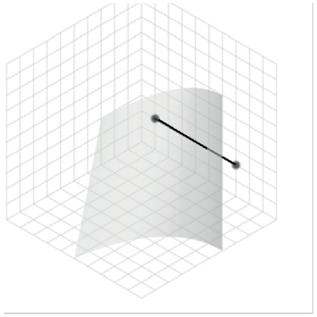
A HISTORICAL MATERIAL PATH



A ZONE OF THE OBJECT



A ZONE OF ‘REAL’ RELATA



A SCREENIC ZONE

A ZONE OF ‘VIRTUAL’ RELATA

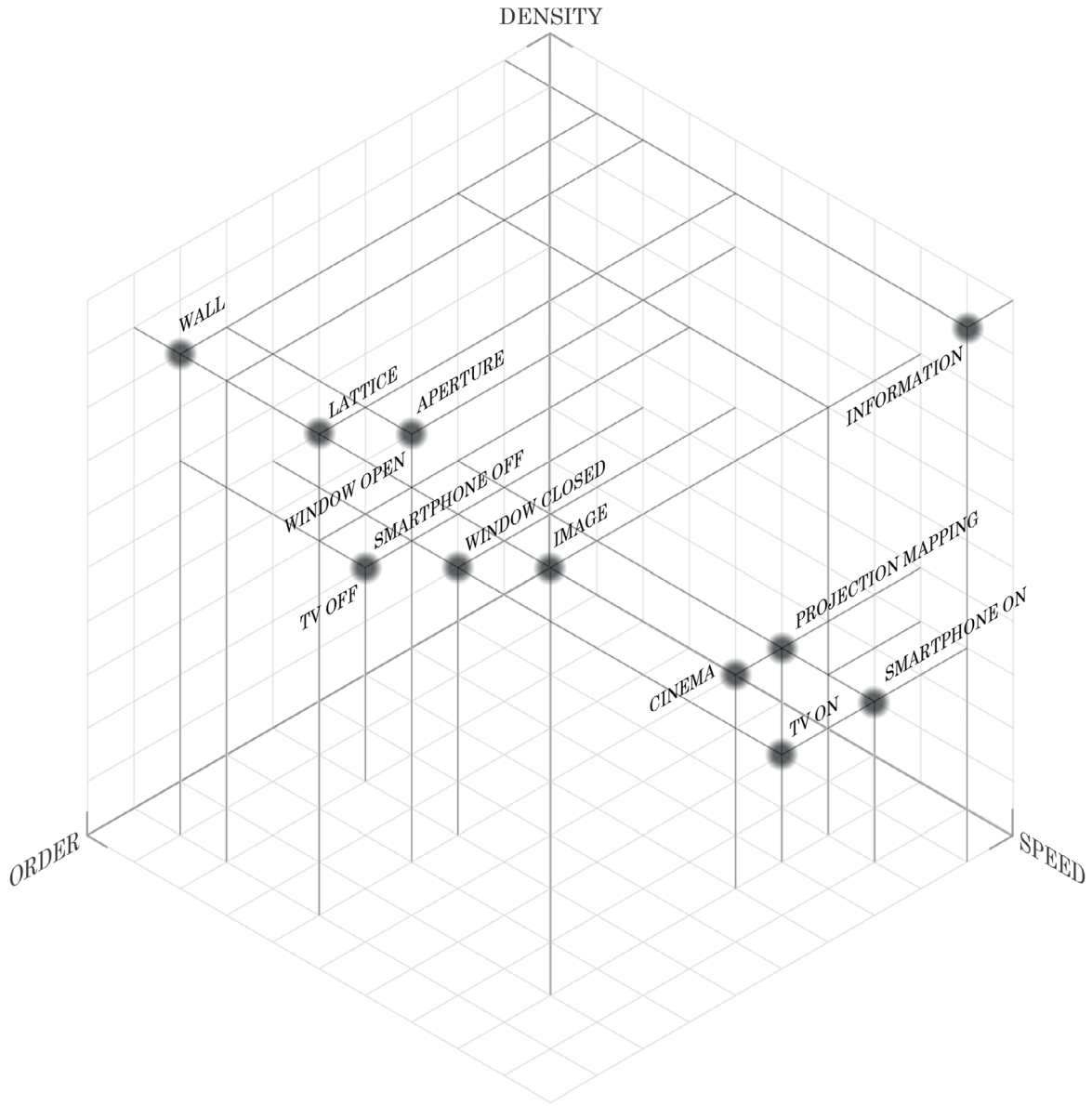
AN OUTSIDE

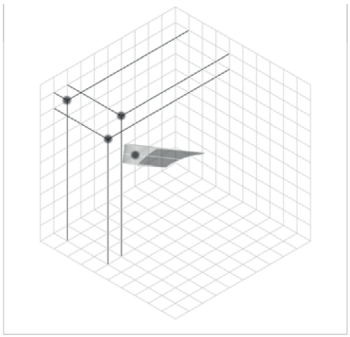
ORDER Resolution of screenic relata

DENSITY Screen-person homology

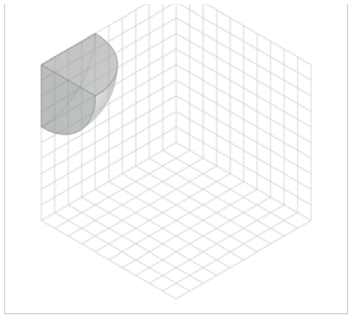
SPEED The working speed of the screen

A SCREEN THAT IS ORDERED

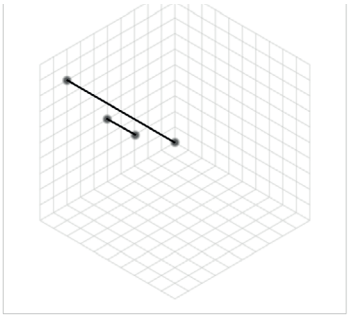




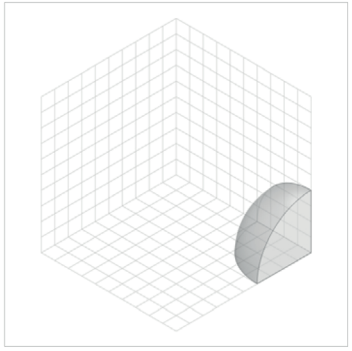
THE WINDOW'S TRANSGRESSION



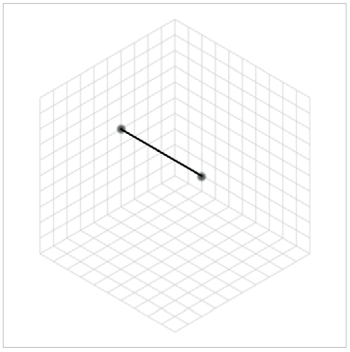
CINEMA'S TRANSGRESSION



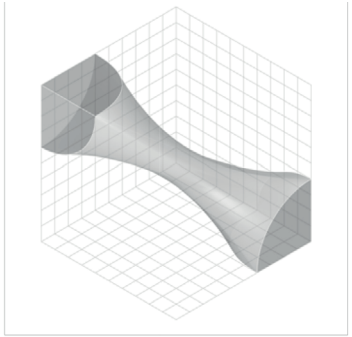
A CINEMATIC ZONE



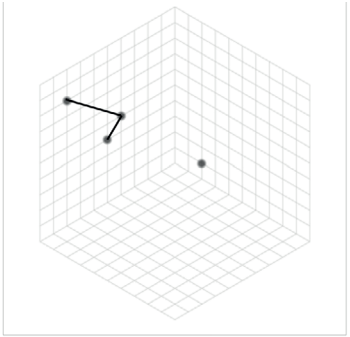
THE TV'S TRANSGRESSION



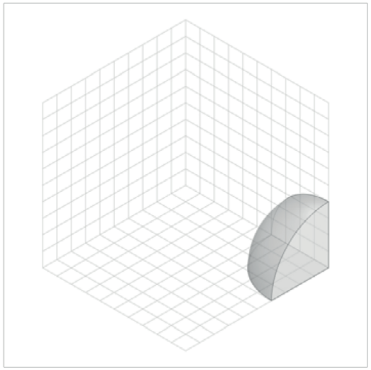
A TELEVISUAL ZONE



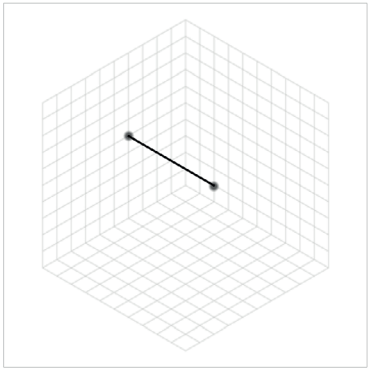
THE SMARTPHONE'S TRANGRESSION



A PHONE ZONE



A ZONE OF FLUX

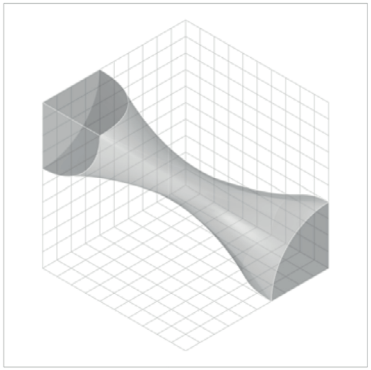


A FIRST SPLIT: SUBJECT AND SCREEN

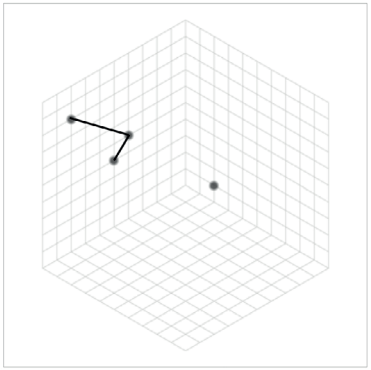
ORDER Internal difference

DENSITY Part-person homology

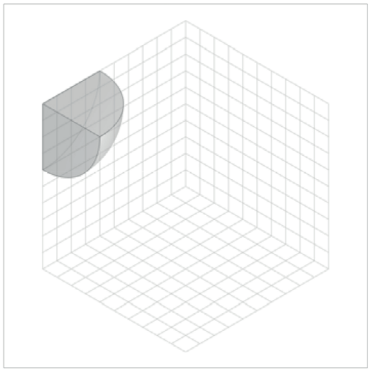
SPEED The working speed of the parts



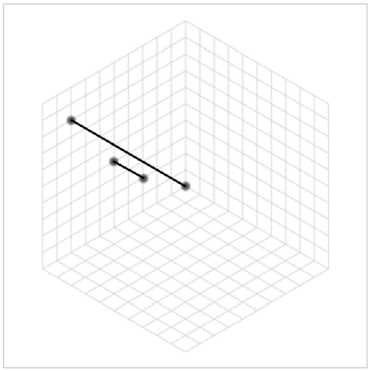
A MOVEMENT OF MATERIALISATION



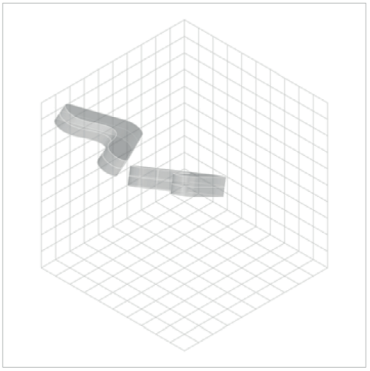
A SECOND SPLIT: OBJECT AND IMAGE



A MATERIAL ZONE

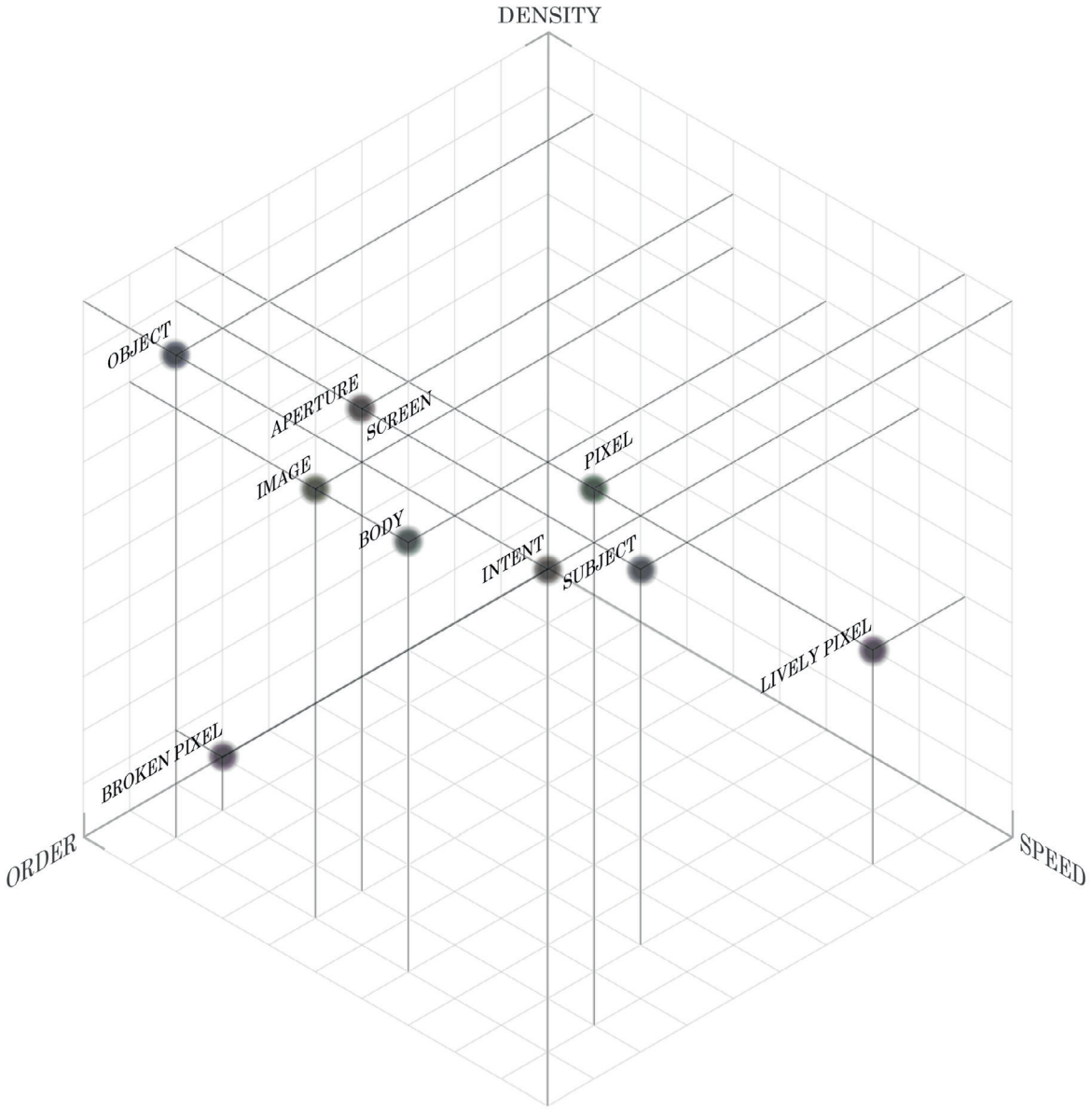


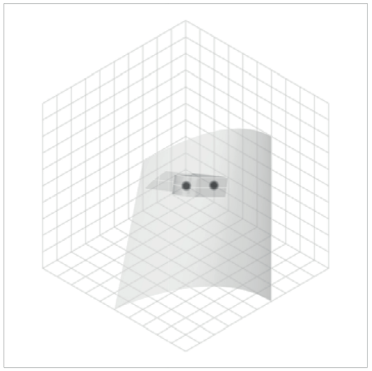
A DOUBLED RELATUM



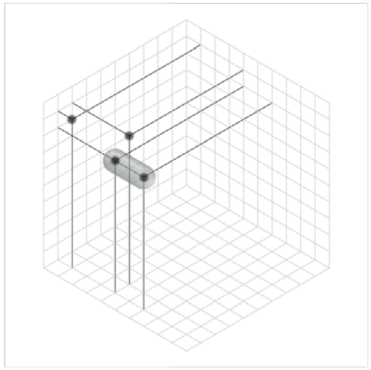
A SCREEN AND A SUBJECT

SCREENIC BOUNDARIES

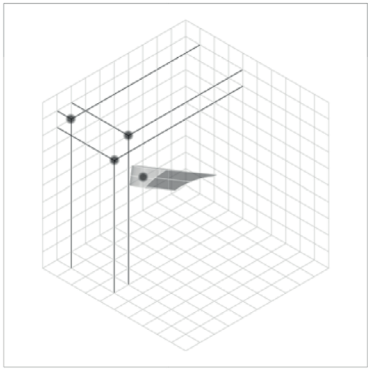




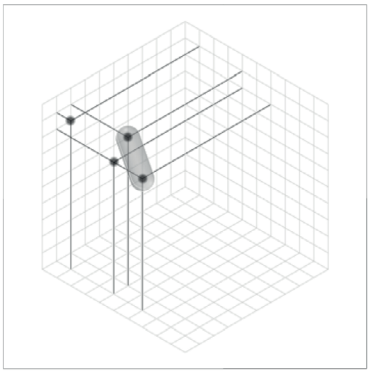
A CRITICAL THRESHOLD: THE SUBJECT'S SPEED



PROXIMAL IMAGE



A BODY, A SCREEN, AN OBJECT, AN IMAGE



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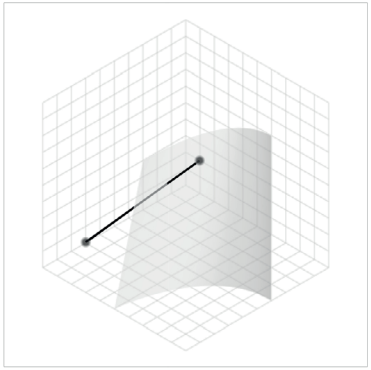
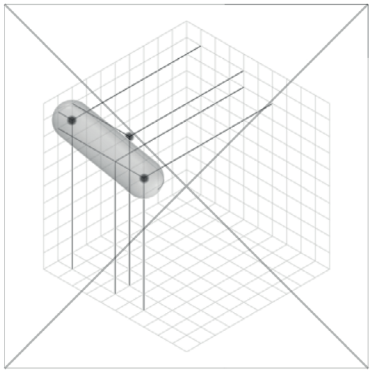


AN UNRESPONSIVE PIXEL



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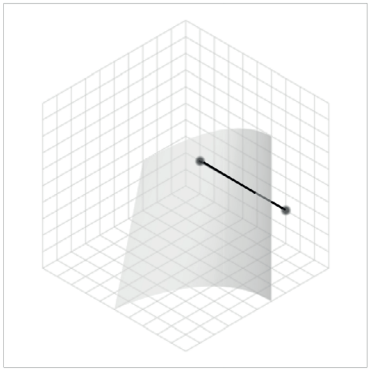

AN ERRATIC PIXEL

CONCLUSION

The screen and relational ontology

CONCLUSION

This thesis has examined the screen across three modes of thought, using a variety of methods. In doing so, this thesis was able to generate an understanding of the screen across different sets of assumptions and different material biases. What arises is a conceptualisation of the screen – not a screen *per se*, but a way of working and a new understanding that was generated from that way of working.

This thesis began with a brief exploration of screen analysis. It discussed published findings on the screen and the methods used to produce those findings. It noted the screen's ubiquity, its pervasiveness in structures of thought and communication, and its diverse materialities. It showed that the screen has been defined through commonality as well as through the fundamental change, through what it represents as either the imagery it bears or the social meanings it holds – but not so often according to its materiality. It also noted that a focus on materiality was an important part of being able to translate screen experiences into designed objects.

Then the thesis moved to addressing what the screen *is*, its ontology. This did not involve setting out to answer the question of the screen's existence by isolating common features of screens, either materially or conceptually. Rather, it meant approaching the screen from within the mechanisms of perception, as a relational device. Particularly, it meant exploring the ways in which the screen surfaces in perception, and connecting the resulting understandings of the screen to the structure of the arguments that produce them.

This approach resulted in a survey of screen understandings. However, this research reaches beyond reporting the ways that the screen is understood. By understanding the connections between what is found and the way it is found in each case, two interconnected and important understandings were allowed to surface: firstly, that each set of screen understandings had a position in regards to the others; and secondly, that there was always something that escaped the mode of thought – an excess to screen experience that cannot be positioned within any individual mode of understanding. These understandings allowed the generation of a map of the screen. Looking across the different constructions of the screen allowed the identification of things that reoccur, and things that escape entirely.

This conclusion will discuss the insights and impacts of this research and what it has been able to say about the screen. It will begin by discussing the research aims, and the conclusions

that were drawn against each chapter. It will then move to discuss its own way of working and the impact of the methods on what was found out about the screen, and will conclude with a discussion of the limitations of this research and its potential impacts on the field of design.

Answering questions

The aim of this research was to describe an ontology for the screen, in the hope of understanding the individual material nuances that present themselves within this ontology and the different kinds of effects of screens on daily life. This drew out some specific questions: one, what does it mean to see a screen as a screen; and, two, what is the role of materiality in the screen's ontology? I will now discuss how the thesis addressed each of these questions before summarising the ontology of the screen as it was found.

What does it mean to see a screen as a screen?

There are two parts to the question of what it means to see the screen as a screen: the object of discovery (the screen) and the discovery itself (the act of seeing). Although previous studies had discussed the object of the screen in various ways, this thesis' development and contribution lay in connecting these understandings of the object of discovery to the process of discovery – the way of looking.[1] This was achieved by isolating three ways of looking at the structure of relational ontology: the first held the relata as ontologically primal, the second held the relation as ontologically primal, and the third bound the two within an immanent structure of relations.

The ways in which the screen could be understood through the relational encounter were the subject of the three chapters, and each generated a different understanding. In this way, a series of discoveries were made about the screen. Chapter one approached the screen by holding its relata as primal. It looked at what could be determined about the screen, and examined two major screen dichotomies – the subject and the object, and the real and the virtual – as they played out in screen experience. Using this structure, chapter one concluded that disappearance and negation are the ontological basis of the screen, and that this negation leads to an understanding of the screen as creating a gap. Chapter two considered the screen by holding relations as generative of and primal to relata, thus inverting the priorities of chapter one. It looked at the indeterminate of the screen and examined materiality and agency as generative relations that result in screenic relata being determined in perception. Using this structure, chapter two concluded that the screen has a material directedness that works alongside humans to order space, and that this leads to the screen being recognised as a particular point of tension in agency and materiality. Chapter three approached the screen as an immanent relational structure, in which relata and

relations are bound and from which they emerge at different scales. It positioned the screen as an assemblage of different material and conceptual individuals, which could be revealed at different times. Using this structure, chapter three concluded that the ontology of the screen is reliant on the parameters of speed, order and density; as these define regions of stability for screenic relata, and boundaries where critical transitions take place between relata.

Each of the chapters has a different answer for what the screen *is*. The screen as a gap between the real and the virtual or the subject and the object is a different kind of screen to that which shows as a tension between materiality and agency; which is different again to the screen as a particular region of speed, order and density. Each of the chapters, therefore, showed a different aspect of the screen. Each of these ways of looking carried its own assumptions and logical structures that gave a particular understanding of the screen. In order to contextualise these different explanations, the discoveries of each chapter were connected back to the assumptions that structured the mode of enquiry.

In holding the relata as ontologically primal, chapter one gave preference to determinate entities. As such, it described the screen in a highly ordered way; as one part of an interaction of dichotomous pairs. The analysis found, however, that there were slippages in these dichotomous pairings. To maintain the integrity of the analysis, the screen had to be split and split again – indicating that the screen did not quite 'fit' conceptually with the order by which it was being described. This chapter particularly noted the importance of material and agency in interrupting the ordering of the screen. Importantly, chapter one aligned the discovery of the screen as a gap or negation to the creation of gaps and negations within the structure of the analysis.

This gap was then examined more thoroughly in chapter two by focusing on the relation. The chapter looked at materiality and agency as generative relations in order to examine how contradictory screen relata can surface differently in different contexts. In this way, it focused on the indeterminate, the parts of the screen's ontology that are not highly ordered. In doing so, the analysis found that the screen participated in an ordering itself, one that was at odds with the system of determination demonstrated in chapter one. In changing the way it looked at the screen, chapter two allowed some resolution of the excess of chapter one's screen. It particularly notes the importance of time and scale in revealing the screen. However, without modes of determination, there was little that could be said about the screen. That is, the indeterminate focus of the analysis found indeterminate outcomes.

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1. Martine comments: "There must be meaning. That this search is worthy ...surely stands, if anything does, without argument. However it cannot be carried out intelligibly without constant reappraisal of the extent to which the character of the search itself affects what we find." Brian John Martine, *Indeterminacy and Intelligibility* (Albany: State University of New York Press, 1992), 15.

Chapter three took ideas of the production of difference from chapter one, and of time and scale from chapter two to develop a relational structure of the screen. The relational structure provided a manner of connecting determinate and indeterminate aspects of screen experience by establishing each relata as an assemblage – a region of screen experience that exists at a certain scale, with possible transitions between. Chapter three then established that this virtual region could be imaged, or mapped, by defining its topology. It overtly discussed the positioning of chapters one and two and, from this, developed the axial parameters of order, density and speed. The map, however, is always bound by the parameters that define it; and so the image that is produced is defined by the choice of parameters.

In short, this thesis found that seeing a screen *as* a screen was less about the screen itself, and more about the mode of seeing.[2] To put it simply, what we find is how we look. If enquiry asks about the screen's impact on the virtual and the real, an answer will be found that establishes the virtual and real as separate, so as to allow the screen to mediate between them. The initial assumption – the pre-given separation of the virtual and real – defines the outcome of mediation. If a screen is to be seen as a screen, it needs to be seen across a number of frameworks in a way that allows each conceptual structure to remain alongside the others.

Unfortunately, this precludes any sort of definitive answer to what the screen *is*. Any answer to this question would involve a reduction, a homogenisation of conceptual and perceptual structures. After all, experience is not wholly determinate and neither is thought: "the indeterminacy of our beginning reaches through the process to colour and shape the whole in such a way that our reflective labour must always remain, at least in this sense, incomplete."[3] Although this thesis has not provided an answer to what the screen is, it has given an indication of a range of screen experiences and the role of perception in finding the screen within these experiences. In this sense, it has traced a topology of screen experiences, and allowed an understanding of what it means to see the screen *as* a screen.

What is the role of materiality in the screen's ontology?

I will turn now to the second question regarding the role of the material in the ontology of the screen.

The relata-based analysis looked at the material of the screen from the universal, *the* screen, and the individual, *a* screen. When the materiality of the screen was approached from the universal, it began to take on distinctly nonmaterial properties. Although individual screens have materiality, the screen as universal does not – it dissipates into a type of force that acts on

the embodied and/or social being of the subject. If properties were sought that allow the screen to affect subjectivity in these ways, the screen must be approached on a different scale – these properties cannot be described without individuating the encounter. As a general relatum, the screen becomes a mediator, a repository, something that demands attention; but these qualities cannot be linked to its material form.

When the materiality of the screen was approached through the individual encounter, distinct material properties belonging to an object could be connected to particular reactions, behaviours and understandings in a subject. This understanding relies heavily on the relation of use and the recognition of objects as being materially fit for a specific human purpose. In regards to the ontology of the screen, the emergence of an object *as* a screen relies on the form and behaviour of the material object suggesting 'screenness'. But this reflexive relation of material and ontology could only be generalised so far before it introduced contradictions – before dichotomous pairs such as opaqueness and transparency could both result in a screen. Instead, these material qualities need to be homogenised – an undertaking that resulted in losing the material qualities. Opaqueness and transparency both create a barrier, and it is the barrier condition that is responsible for the screen. The stronger or broader the generalisation, the more difficult it is to retain the materiality of the object.

The materiality of the screen is compromised within this form of analysis, and cannot be held responsible for the emergence of the screen in perception. The specific materialities of the screen had a minor role in determining the ontological condition of the screen in the relata-based analysis. The screen was connected instead to a lack of materiality, the disappearance or negation of the material, both to and from the screen. But this material nullity is intimately connected to determination. In trying to keep the subject separate from the object, and the real separate from the virtual, the materiality of the object was removed from its effects. The screen was split so that it could have an individual, inert material but no impact; or a universal, forceful lack of material.

Or, to look at the matter another way, materiality was integral to revealing the screen in perception. Materiality and agency are put at odds, one belonging to the subject, the other to the inert object; one to the real and the other to the virtual. The difference responsible for these relata is itself a material difference, a difference that the screen is very good at challenging in

2. Heidegger notes the inseparability of these two notions in *What is a Thing*: "The question [of what is a thing] has been characterised in two essential respects: What is put to question and how it is questioned." Martin Heidegger, *What is a Thing?*, trans. WB Barton, Jr. and Vera Deutsch, analysis by Eugene T Gendlin (Chicago: Henry Regnery Company, 1967), 53.
3. Martine, *Indeterminacy and Intelligibility,* xv.

its roles of barrier, frame and site. Negation and disappearance imply that there is something to be negated, but rather than the specific properties of what is negated defining the identity of the screen, it is the negation itself that is important. The material of the screen is both itself and something else – it is what it is not.

The relation-based analysis made the importance of the screen's material clearer by redefining materiality as a generative process. The screen acted materiality and was acted upon as material, resulting in a material difference that happens both to and from the screen. This suggests that the screen has a role to play in generating materiality at the same time as being generated by materiality; that the screen participates in an ongoing materialisation at the same time as it lies outside of it. This introduces a paradox for the subject, who also needs to be found both within and outside of ongoing materialisation – alongside the static object of the screen at the same time as it is found alongside the material produced by the screen. The material reciprocity of the screen and the subject (as a thing and a body) means that the body remains generative against the space of ongoing materialisation, the space of movement to the other side of the screen. Yet the material object of the screen, and the reflexive body that arose with it, works against this ongoing materialisation. The materiality of the screen is in competition with itself – not in generative terms, but as a result of a person attempting to find a stable, situated reflexive embodiment – to determine the ongoing relation into static relata.

The interaction between these ongoing and static materialities results in nuances in the ways that screens present materially, because it influences the ways that relata can be determined from the material relation. In this sense, materiality itself exhibits agency. The screen has a material directedness – a particular style of effecting and reciprocating other materialities – that results in an agency. This directedness in dependent on the screen seen from other scales – on pixels and apertures and on informational structures. It is only on determination, a reflexive process, that this agency is severed from the material. Material directedness introduces a fundamental contradiction in that the active materiality of the screen interferes with determining an 'inert' object: the boundaries drawn around its effects do not allow it to be seen as inert material, but as a productive force. The screen's material directedness can only be accessed by delaying intent and relying less heavily on use as a major relational framework. By looking at the use-less, the interaction is less readily determined, the indeterminate hangs around longer, or different determinations are made which produce different relata.

The idea that the same relation can produce different materialities implies that the materiality of the screen may be larger than its individual instance. Chapter three looked at the role of this

aspect of materiality in the ontology of the screen – as a relational structure that allows a view of the screen as a relatum on the same ontological level as the processes that produce it. This immanent structure meant looking at the role of the material in the concept of the screen as well as its individual instance, in finding the material in the 'screen' as a general class noun or concept comprising specific instances of screen experiences as well as its compositional materiality. Changes in the meaning of the term 'screen' are accompanied by changes in its materiality – the term references a variety of material, and sometimes contradictory, instances. The material of the screen is itself decomposable into smaller things such as apertures, photons, and light emitting diodes. The term 'screen' does not necessarily refer to one of these materialities; just as the term, as a class or universal, does not always refer to a particular instance of the thing. If materiality is to be considered in terms of the general, however, this universal has to sit alongside the individual context.

The immanent framework of the assemblage allows this to happen: meaning is held at a certain scale of interaction, where a region of material experience is delineated, perceptually bounded into something called a 'screen'. This region might contain spaces, objects, subjects, real things and virtual things, but it also relies on generative processes of materiality and agency in the way the region becomes bounded. The screen thus arises where material difference is found, where the strata can no longer be homogenised and have to break apart into another scale. Rather than holding meaning in particular material properties, the screen's ontology comes from this region of possibility – a mapping of all material instances on to one another at the appropriate scale.

So, in looking for how the materialities of the screen interact, materiality is turned into an expression of the immaterial, the possible. But it also remains as the static 'material' of the relata, and the generative relation of material difference. In this sense, materiality is the very structure of the screen, it defines how the field of possibility is actualised. Imaging this region – making a map – revealed the materiality of the screen as it is found in a possibility structure across its individual material instances. The individual material instance of the screen both embodies the screen at this larger scale, as well as expressing it materially.

The role of materiality in the screen's ontology is, therefore, complex. It is, again, highly dependent on the conceptual structure with which the screen is approached. In other words, the ontology of the screen either relies heavily on materiality, or not at all, depending on how materiality is defined. And this materiality itself might be determinate (as the timber of the lattice or the plastic of the television set) or indeterminate (as the data encoding the signal or a possibility structure of the pixel). The materiality of the screen at one scale challenges

its materiality at another. Again, no definitive answer can be drawn as to what the screen *is* in regards to its materiality. However this thesis has outlined some dependencies between materiality and the ontology of the screen: firstly, that the screen generates material as well as being composed of it; secondly, that the material of the screen is dependent on an interplay between material difference and sameness; and thirdly, that the material of the screen changes dramatically depending on the scale at which it emerges.

The ontology of the screen

In describing the ontology of the screen as it relates to material difference, it seems most fitting to describe the screen according to the structure of its relationality. This structure allows both relata and relations to be considered, and best addresses the role of the material in the screen's ontology. To simplify the matter, an answer to the question "what is the screen?" might read something like:

The screen is a structured region of possibility which is actualised at different scales, in different ways, at different times. The screen is structured along questions of order, speed and density; and includes determined material entities – such as pixels, apertures, information structures, lattices, televisions, and smartphones – as well as indeterminate relations and excesses – such as sociocultural forces, identities and generative material interactions. These sets of entities are structured in relation to one another, but this structure can never be fully determined: any mode of determination relies on restrictive assumptions to generate understanding, and something will always escape these assumptions.

This may not seem a very useful kind of statement for those wanting to design screens, or design with screens or through them. But it is effectual, in that it outlines a territory to be explored and limits of exploration – both in terms of the limits of the ontology of the screen, and the limitations of ways of exploring. The contribution of the ontology of the screen that this thesis presents will be discussed later, but first I would like to focus on the impact of the methodology this thesis used in defining this ontology.

Impact of methodology

The three major methodological moves of this thesis were dividing the analysis along the different ways of looking; approaching these ways of looking according to a making-and-breaking using different methods of interrogation; and figuring each in a way that allowed the analysis to be understood diagrammatically. Each of these methodologies contributed to the understandings drawn from this thesis in a particular way.

Dividing the analysis

The analysis was divided into the three frameworks or perspectives of relata, relations and relationality; and these three ways of looking were held apart as long as possible – both spatially, in separate chapters, and conceptually by means of separating their assumptions and ways of working. This resulted in a strained analysis at times, particularly in the first two chapters. Holding these ways of thinking apart meant that individual concepts were isolated from their contexts. In this isolation, many of these concepts changed, even to the point of a naïve reading. This was particularly noticeable for those theorists that reoccurred across the frameworks. This move is not intended to disrespect the oeuvre of works of these theorists, or to misread their contributions. Instead, this isolation performs in a similar way to the bots – it intervenes to 'break' the analysis, and thereby to show the structures of thought behind it. The isolation of a particular concept from its context can be jarring for the reader. This is, however, the exact task that examinations of the meaning of screens often carry out: both technological and social determinist views of the screen generalise from specific instances to the point of losing the context of the analysis. By holding these modes of thinking apart and leaving the jarring moments unresolved, this thesis performs the task that it critiques with self-awareness; making clear the assumptions that allow these slippages of meaning to be constructed.

It is clear, in the end, that these modes of thought cannot be held apart. Relata cannot be discussed without reference to relations, nor relations without reference to relata. Assuming one as ontologically prior to the other misses the point of their interdependence. But discussing them together – homogenising them into a single understanding – would mean priorities would have to be determined and concepts debated on unequal ground. If they had been folded into a single framework, the contradictory definitions and understandings would have to be immediately resolved. Leaving a contradiction as a contradiction for a little longer instead opens an indeterminacy in analysis. In making clear the assumptions that perpetuate the separateness of these modes of thought, and discussing the impact of these on the conclusions drawn, a new understanding is found across the modes. These modes of thought produce different, contradictory understandings. They are allowed to exist in heterogeneous multiplicity.

4. Martine comments: "when we treat analysis as the single most significant method of investigation, presupposing as we must that the world is made up of discretely meaningful bits and pieces, the conceptual structures in terms of which we articulate the relations among those pieces…are predestined to take on the same character as the pieces that we set out to look for in the first place." Martine, *Indeterminacy and Intelligibility,* 15.
5. "If for no other reason than that in each case some other end is possible at least in principle, the claim that the determinations we have come upon at the end of the process are not really ideal structures that were undergirding the process (together with everything else) from the outset seems more and more reasonable." Martine, *Indeterminacy and Intelligibility,* 15.

Making-and-breaking

Martine notes that determinist frameworks are self-perpetuating in that they cannot accommodate any mode of understanding outside of analysis.[4] In other words, the way we interrogate a phenomenon restricts the possibilities of what we might find it to be. Analysis disregards the indeterminate because it cannot account for it. In this sense, he claims, determinism creates things rather than discovers them, a premise in direct conflict with the aims of determinist agendas.[5] He then suggests that, if we focus on the "pervasive character" of the indeterminate, it seems as though the determinate is an incomplete expression of an essentially indeterminate world, rather than the other way around.

The making-and-breaking approach to analysis found the limits of a particular structure of thought and helped to clarify the assumptions behind each mode. In this way, the conceptual and written 'making' of the screen – which tends toward the universal and the determinate – was challenged by a 'breaking', which intervened at particular places to find excesses and individual context. This involved three forms of creative practice: amateur robotics, animation and personally situated writing. The works played a significant role in the development of the project, and contributed to the analysis by providing an alternative access point to screen relations. Together, these methods challenged the conceptual analysis by finding and provoking the limits of the mode of thought.

The thesis performs between these modes of 'making' and 'breaking'. The two halves were established in varied spatial relations, resulting in a thesis that changed presentation in response to the content it was covering. The relata-based analysis of chapter one favoured the determinate, and bent the indeterminate around the structure it presented. The text of the 'making', then, was presented within this chapter as a single column emphasised in red; and the 'breaking' as two columns manipulated into this structure. As the 'breaking' increased in density, it began to interrupt the flow of 'making', cutting the analysis into physically smaller pieces. The relation-based analysis of chapter two favoured the indeterminate, and attempted to bend the structure of analytical writing to discuss excess and between-ness. The priority of the two halves is inverted, and so too is their presentation. The 'making' in this chapter is broken into two columns, and the 'breaking' presented as a single flow of vignettes, emphasised in blue to position it as the opposite of the previous chapter's emphasis. Chapter three approaches the 'making' and 'breaking', the determinate and indeterminate, as equivalent modes caught within a structure. The text reflects this by combining the two streams into a single flow and introducing a third colour, green, to complete the RGB colour system.

Figuration

To emphasise the interconnections across the thesis, each of the chapters was conceived as a figure, which depicted the conceptual structures of the written analysis and the way that the creative practice interrupted this structure. These figures were analogistic, but they were also performative. Within the chapters, assumptions were made and connected back to the conclusions that had been generated. Each time this happened, another dimension was made in the figuration. Chapter one's figure was presented as an axis and a cut, chapter two as a stretched plane, and chapter three as twisting a field.

These figures generated understanding of the ways in which the 'making' and 'breaking' worked in each chapter, the dimensionality with which they interacted, and they allowed the findings to be diagrammed spatially. These diagrams could then be used to connect findings across the chapters, and to depict the topology of the screen as it had been discovered through the thesis.

Methodology summary

Together, these methodological moves provided a number of different structures across which commonalities and differences of understanding could be found. Each of these different structures had implicit assumptions and ways of accessing understanding that influenced what was found. Any ontology is situated. That is, we only ever have access to a thing through our own access, and this access has a bias. If the screen is to be found from its ontology, it needs to be clear what belongs to the bias of access and what belongs to the screen.[6]

The possibilities of the screen, in both its material and conceptualisation, exist across these ways of looking and provoking. By allowing a set of understandings to remain alongside each other, to remain multiple, it becomes apparent what of the outcome belongs to the conceptual structure and what belongs to something else, something outside. The multiplicity of these understandings allows us different foci at different times – to express differences or similarities as needed, to understand the full scope as well as particular contexts and details.

Limitations

Each of the modes of thought analysed in this thesis bore assumptions that impacted on its conclusions. This thesis is no different, and the research presented herein is by no means a

6. Deleuze and Guattari write "[t]he multiple must be made, not by always adding a higher dimension, but rather… with the number of dimensions one already has available – always n-1 (the only way the one belongs to the multiple: always subtracted). Subtract the unique from the multiplicity to be construed; write at n-1 dimensions." Gilles Deleuze and Felix Guattari, A Thousand Plateaus, trans. Brian Massumi (Minneapolis: University of Minneapolis Press, 1987), 6.

comprehensive account of the screen's ontology. The assumptions that this thesis imported into analysis include both limiting *what* was seen and limiting *how* these things were seen.

The object of enquiry was limited in two major ways that affected the kind of discoveries that could be made. Firstly, the 'screen' was limited to a material instance in its context, though this context was conceptual as well as material and spatial. Secondly, the 'screen' was limited to having a relationship to moving space, either through imagery or filtering. The purpose of these assumptions was to anchor the analysis within the field of design and spatial experience. But this also meant that certain issues came to light more than others. Particularly, a desire to locate the material within the screen's ontology led to defining the subject and object and virtual and real as the beginning points of enquiry. This led to materiality and agency taking a strong role within the thesis, which in turn helped define speed and density as axial parameters. A focus on spatiality limited the kinds of effects that were considered relevant to the analysis, the types of examples that informed the argument, and the outcome of that argument as an abstract spatial representation of the screen.

Included in the limitations of the objects entering into enquiry is the perceivable commonality between the creative works. This commonality could be defined in various ways – according to the technological nature of the artefacts, their ability to move, or even their size. Each of these parameters might be of interest to others as they assess whether to include or exclude the findings of this thesis within their own analyses. However, to dwell on these parameters here runs the risk of returning to a relata-based analysis – of defining effects according to the physical properties of an object. Instead, it can only be said that the ontological relations entered into with, and explicated through, the creative works is of a particular character; just as the works themselves are of a particular character.

The thesis also defined a particular mode of enquiry. Approaching the ontology of the screen as relational according to the three frameworks put emphasis on ordering as a way of producing understanding. This influenced the argument that the screen was itself a form of ordering in conflict with the human, and the definition of order as an axial parameter.

I could only define the ontology of the screen as it appeared under the restraints of this thesis, but these limitations do not disvalue the outcomes. There are, of course, more ways to look at the screen. Different sets of assumptions would generate different foci and different answers to the structure of the screen's ontology. This project could be continued *ad nauseam* – by looking more closely at any of the relata that have arisen here, for instance, or conversely by looking across more contexts. There are always more gaps to fill. But such a project is, by nature, incompletable

– there is always another individual instance to include in the collective, or another way to draw perceptual boundaries around phenomena.

What is included here is a subset of the screen's ontology that suffers from particular limitations. As with all conceptualisations, it is created more than discovered. But it is done so in a way that attempts to locate its own argument within the understandings it generates, and in this way it provides a situated knowledge.

How far the findings of this thesis can be generalised is dependent on the reader's interpretation of the limiting factors of the research. As with any research, the more commonalities that can be found between the contexts addressed in this investigation and the new context to which it is applied, the stronger the argument for extrapolation. Should the reader choose to focus on the largely technological nature of the artefacts discussed, the findings could safely be generalized to technological screens as a whole. If the ability of the objects of discussion to move is of more importance to the reader, this generalization might be better limited to mobile screens, or to screens that move autonomously.

My hope is that this thesis has demonstrated that none of these potential generalizations is intrinsically more valid than the others. Although this investigation has revealed just a small, incomplete set of ontological relations within the field of possibility of the screen, the methodological approach has made clear that these relations form part of a structure. Exploring, understanding, and manipulating the relational structure of the screen will always show commonalities to some sets of relations and differences to others.

Design, the screen, and this thesis

The findings that have arisen from this exploration of screen ontology act as a topology of screen understandings. They provide insight into what screens have in common, but also into how they arise differently in their contexts. This territory of 'screenness' locates the individual encounter amongst generalised understandings.

My own bias lies in design, and this is the discipline where I hope this research can contribute most. Design is understood in the context of this thesis as a methodology, a system of thinking and doing that pays particular attention to the role of materiality in meaning. Its varied sub-disciplines are defined by applying this methodology to different subject matter – to architecture, interiors, objects and interfaces.

Yet this thesis is not strictly about design. Instead, it uses design as a practice to connect theory from the borders of the discipline to material expression in a way that produces new understanding. Design has not been the object of this thesis, but it has been used in this research as a method of connecting ideas to material in a number of ways: in the making of data to provoke analysis, in the interpretation and representation of that data, and in the establishment of the argument.[7]

The findings that arise within this thesis arise from these design methodologies. These are located amongst other forms of situated knowledge, as a method of theoretical interrogation that produces certain kinds of outcomes. Design is embedded in this thesis as part of a process of understanding: as a mode of critical thought that focuses on links between material and conception. The *things* that are produced using design methodologies in this thesis – the bots, the animations and videos, the creative writing and even the thesis itself as a curated presentation of this process – are not the separated products of the thesis, rather they are part of its workings. Design disrupts written analysis at the same time as it works alongside it. It produces different understandings, acting as a counterpoint to written analysis, another way of looking that is outside of analytical literature.

But what can be taken from a design thesis that talks so little about design itself? … by looking in to these structures strengthens these restrictions rather than loosening them. This thesis acts as a performance of a methodology that interrogates things using design methods alongside analytical methods. It demonstrates a mode of design and analysis that is not deterministic.

Although there is a continuing (and, perhaps, increasing) undercurrent of alternative design processes, formal and functional concerns remain the dominant paradigms within design practice. Much of conventional design is determinate. The affordance framework, for instance, determines use from form. Many design products, especially technological products, are produced in determinate ways – they connect human needs and desires to aspects of form and operation to make products that are *more* useful, *more* beautiful, more *for humans*. Johan Redström's discussion of technological design epitomises this approach. Redström argues that "as we turn to these things, we do not only have to re-locate the functions of technical objects within a rich context of use; to understand the presence of technical objects, we also need to consider the materials that build them." His examination of technological design asks designers to develop frameworks of use by "probing into possible use scenarios and user expectations" when designing new technologies.[8] In some ways, this thesis supports such an approach. It provides understandings that link the structures of human perception and material to the ways that screens are perceived and used. However, its ethos argues the opposite: rather than developing

traditions and expectations as to how products behave, we could attempt to dismantle them.[9] Such a move would emphasise uncertainty, reinvigorating the products of design with their own vitality. In this regard, this thesis has also explored the role of design in the indeterminate, posing problems such as non-designing things and designing non-things.

Connecting design to the excess of determination is not, in itself, new.[10] Many of the projects discussed in chapter two – Niklas Roy's *My LittlePiece of Privacy* and Random International's *Audience*, for example – use design in a way that prolongs the process of determination and accentuates what comes before or during this process. Architectural theorists such as Cache and Massumi have discussed design techniques and methodologies that accentuate the indeterminate. This thesis also supports finding excesses of the screen's determination in that it highlights regions where human perception and screen's material directedness are mismatched.

This thesis, then, allows for an awareness of how the determinate and indeterminate aspects of experience sit side-by-side.[11] Moreover, it demonstrates how this awareness can be fostered in a way that can be transferred across disciplines. It demonstrates a series of techniques for shifting the determinate to the indeterminate, isolating critical points of transition between the two frameworks. These techniques will become increasingly important as the challenges of working across disciplines and without definitive frameworks of knowledge deepen.

In terms of design, it suggests a series of interventions – a design process based on mapping perception, a series of issues that present themselves in the design of screens, and understandings that can be critically applied to designing with screens and for screens.

Topological design

In the sense that the ontology of the screen is found across each of the ways of understanding it, the conclusion of this thesis, the 'answer' to the ontology of the screen, is a depiction of the

7. These connections were made in the making of the *Behaviour Boxes*, *Gaze Returner*, *Moubie* and the *Some Assembly* bots; in the presentattion of animation and video as layers of interpretation on top of the material; and in the design of the thesis itself as a document; respectively.
8. Johan Redström, "On Technology as Material in Design" *Design Philosophy Papers* 3, no.2 (2005): 39; 44.
9. Hélène Frichot draws on Deleuze and Guatarri's repeated warnings against cliché to demonstrate the dangers of design as a process of fixing use and behaviour. Hélène Frichot, "Drawing, Thinking, Doing: From diagram work to the superfold" *Access: Critical Perspectives on Communication, Cultural & Policy Studies* 30, no.1 (2011): 1-10.
10. Jonathan Hughes's essay "The Indeterminate Building," for example, traces the legacy of indetermination in mid-century architecture. Jonathon Hughes, "The Indeterminate Building" in *Non-Plan: essays on freedom, participation and change in modern architecture and urbanism*, ed. Jonathon Hughes and Simon Sadler (Oxford: Architectural Press, 2000).
11. Gretchen Wilkins and Andrew Burrow refer to this type of completed incompletion as a "final draft" in their article of the same name; and it is a quality they find missing within the strict regulatory and financial restrictions of architectural design. Gretchen Wilkins and Andrew Burrow, "Final Draft: Designing Architecture's Endgame" *Architectural Design* 83, no.1 (Jan/Feb. 2013): 98-105.

screen's field of possibility. The maps, as abstract spatial representation of the what was found about the screen, is a depiction of the screen as it has been revealed in this thesis.

Chapter one developed a region of the map that showed high order, as the relata-based system is implicitly a system of ordering. Chapter two developed a region of the map that showed low levels of order as generative relations, "always in flux," resist the order of relata. But chapter two also gave hints as to the connections between relata, rather than their differences. Chapter three developed the structural space of the map. It overtly discussed the positioning of chapters one and two and, from this, developed the axial parameters of order, speed, and density. These parameters could then be applied to the findings of chapters one and two to 'locate' them in the map's abstract space.

The maps act as a summary of understandings drawn from the analyses of the thesis. But more than this, they locate these understandings within their own assumptions and restrictions, and in regards to one another. They thereby provide a context for claims made about what the screen is and what it does, connecting these back to the way it surfaces in perception as something experienced and something conceived.

The screen was chosen as the focal point of this research because of the difficulty it poses for established modes of analytical understanding. The screen highlights the complexity of understanding and, in so doing, draws attention to the way that modes of thought connect to what is understood. The methodology proposed in this thesis may thereby be of interest in the disciplines of media and screen studies, as it draws attention to how these fields situate their understandings, and the ways in which that understanding is built and assessed. But the maps created here for the screen could be created for almost any type of object by testing what is determinately known against what cannot be known, and mapping these two domains on to one another.[12] The methods and structure developed within this project could thereby be applied in a variety of design (and non-design) disciplines to create new material forms and new understandings of existing forms. The things that surface from such a process would be a little different to the determined products of functional design[13] – they might acknowledge the human more, or less, or they may not be concrete things at all.

Designing screens

Given the discussions that have arisen in this thesis, is it appropriate to design the screen away, to allow the screen's negation to happen more efficiently? Is it even possible to do such a thing, to design a non-thing? It is clear from the discussions here that the screen never really

disappears. Rather, it crosses a critical threshold and turns into something else – a different relata, a different *thing*.

Industrial and spatial designers may find the outcomes of this thesis, including the map, useful when critically engaging in the design of screen forms. In this sense, the axial parameters of order, speed and density could stand as design principles for the screen: tendencies and capacities that are embodied by the screen's material. Perceptual transitions between screen and pixel, activity and passivity, lattice and television could be explored to challenge existing paradigms of use. Alternatively, these transitions could be acknowledged and avoided, allowing a territory to be defined that safely allows the connection of design intent to design outcome.

Designing with screens and for screens

The disciplines of design, particularly those of architecture and interiors, show an increasing trend toward software- and digital-based design processes and outcomes. Digital design processes are, necessarily for now, accessed through screens. Processes such as 3D printing create new forms of materiality, but they also rely on modelling this materiality on screen in order to produce it. Software-based design platforms also open opportunities for designing the materiality of the immaterial object. Unbuilt work has a long tradition in architectural design. The design process often ends with the production of drawings rather than things – the presentation of concepts as objects is an end in itself. This paradigm is especially pronounced when taking into account design for digital environments, such as user experience design, game design. The design of objects within games and animations, for instance, relies on translating the materiality of actualised objects through the materiality of screens.

This thesis has shown that scale, perceptual access, and accuracy work differently through the speeds and orders of the screen than through the speeds and orders of the material object. When using digital design strategies, a stronger awareness of how the materiality of the screen and conceptual object interact can improve the material result of the design product. Viewing this relation ontologically allows a designer to develop this understanding.

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12. This technique could become a particular affectation of what Anne-Marie Willis describes as an "ontological design" – a design process based on understanding how things arise through worlding and thinging. Anne-Marie Willis "Ontological Designing" *Design Philosophy Papers* 4, no.2 (2006): 69-92.
13. The way things are thought affect their material incarnation. Massumi writes: "the first rule of thumb if you want to invent or reinvent concepts is simple: don't apply them. If you apply a concept or system of connection between concepts, it is the material you apply it to that undergoes change, more markedly than do the concepts. The change is imposed upon the material by the concept's systematicity and constitutes a becoming homologous of the material to the system" Brian Massumi, *Parables of the Virtual: Movement, affect, sensation* (Durham: Duke University Press, 2002), 17.

Concluding remarks

In the sense that it set out to account for the screen's material in its ontology, this research has not been definitive. There are times where this materiality is overtly discussed within the chapters, but on the whole what has been produced here is a collection of words, things and drawings; a conceptualisation of the screen rather than a material incarnation. There is good reason for this, as this thesis discovered: the moment that we step away from experiencing to reflect on experience, the thing in its materiality is lost. Any sort of generalised understanding that can be gained from reflecting on experience suffers from the imposition of the structure of that reflection – an imposition that creates a new entity, a thing that emerges between the structure of reflection, the structure of experience, and the structure of the material.

Although I have, through this thesis, made some assertions about the screen itself and what its materiality means, what has been found out is not a definition of the screen, but a definition of how the screen is understood – a perceptual ontology of the screen. The difference between a definition of the screen and a definition of how the screen is understood is in the way analysis is situated. Definitions of the screen are non-contextual. They remove the analysis from the resultant thing, isolating it from the material and conceptual structures that produced it: the screen bears properties. Or, if analysis tends toward the relation, the definition is simply contingent: it recognises a social or spatial situation and the way that the screen arises in this situation. But there is something missing in both of these approaches: definitions of the screen are not contextual because they do not recognise the role of the definition itself within what is found. *How* the screen is perceived is bracketed out: the definition is of the screen (as perceived). No matter at what scale or level of abstraction I attempt to understand the screen, it is never understood independently of the structures of human perception. A definition of the screen can never be free from the material directedness of human perception, including the structures of thought and embodiment. The screen is a hybrid: a me-screen, or a me-here-now-screen.

If the structure of reflection is what causes this problem, it is somewhat strange that this thesis finds the answer to such imposition in further reflection. The map that concludes chapter three is a meta-reflection; a citing of all the contradictory understandings of the screen back within the structure of the analysis. But the act of turning back into the generalisation – acknowledging the structures of thought and material directedness and their impact on the perceived thing; the assumptions and their impacts on conclusions – allows the hybrid to be recognised for what it is. If enough of these hybrids are superimposed, patterns begin to emerge – regions of persistence and thresholds of change. It is within this structure of sameness and difference that the material directedness of the screen can be found.

Despite not accounting for the material of the screen *per se*, this ontology does account for the role of materiality within screen perception and in conceptualising the screen. It has done this both literally (by creating material things and placing them within the analysis) and analogistically (by discussing conceptions of materiality and where it fits into the process of perception). It describes the screen in a way that is aware of its own restrictions and provides a graphical depiction of the range of screenic possibilities it found and their relations to each other. It thereby provides a situated understanding of the role of materiality in screen ontology.

LIST OF FIGURES

Videos can be viewed via the following link:
https://drive.google.com/drive/folders/1tzI63PZaM1gq7fBaGlKTdeROnBd_sLwX?usp=sharing

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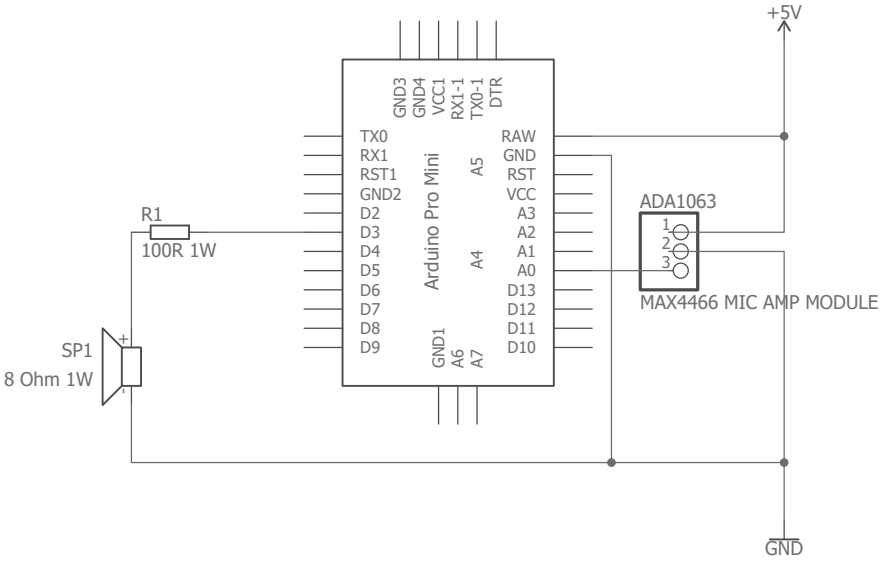
APPENDICES

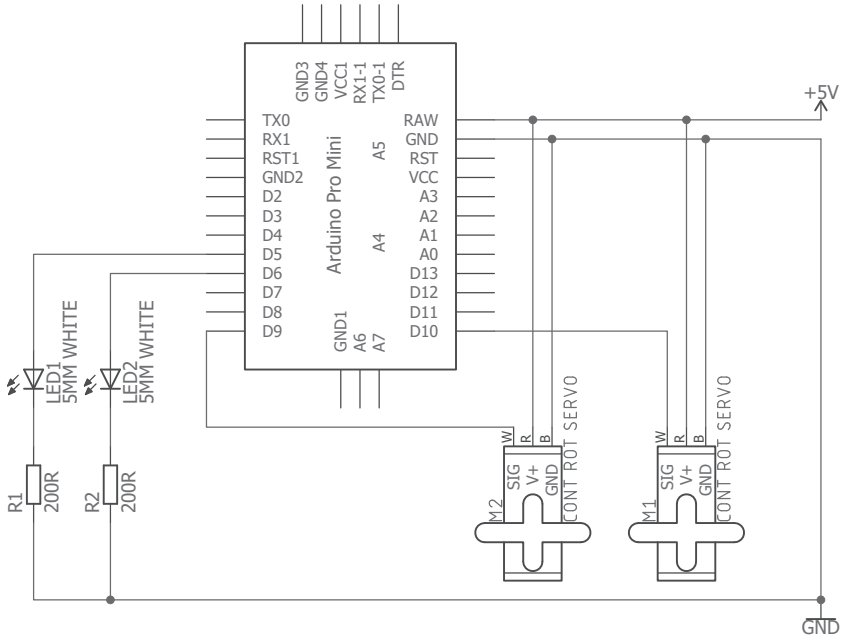
APPENDIX A: PITCHMATCHER TECHNICAL DETAILS




```
/*
Incorporates elements of open source sketch fft_adc_serial.ino by Erich Grunewald, Feb 22, 2016. https://github.com/
erwald/lights/blob/master/arduino/lib/ArduinoFFT2/src/examples/fft_adc_serial/fft_adc_serial.pde.
*/

#define LIN_OUT 1                       // use the log output function
#define FFT_N 256                       // set to 256 point fft

#include <FFT.h>                // include the FFT library

int n;
int average;
int pl = 50;

void setup() {
        Serial.begin(9600);             // use the serial port
        TIMSK0 = 0;                     // turn off timer0 for lower jitter
        ADCSRA = 0xe5;  // set the adc to free running mode
        ADMUX = 0x40;   // use adc0
        DIDR0 = 0x01;   // turn off the digital input for adc0
}
```

```
void loop() {
        cli();
        for (int i = 0 ; i < 512 ; i += 2) {        // save 256 samples
                while(!(ADCSRA & 0x10));    // wait for adc to be ready
                ADCSRA = 0xf5;              // restart adc
                byte m = ADCL;              // fetch adc data
                byte j = ADCH;
                int k = (j << 8) — m;                   // form into an int
                k -= 0x0200;                            // form into a signed int
                k <<= 6;                    // form into a 16b signed int
                fft_input[i] = k;           // put real data into even bins
                fft_input[i+1] = 0;         // set odd bins to 0
                }
        fft_window();                   // window the data for better frequency response
        fft_reorder();                  // reorder the data before doing the fft
        fft_run();              // process the data in the fft
        fft_mag_lin();                  // take the output of the fft
        sei();
        for (byte i = 0 ; i < 10; i++) {
                // find the average size of the FFT buckets
                average = (fft_lin_out[2] + fft_lin_out[3] + fft_lin_out[4] + fft_lin_out[5] +
fft_lin_out[6] + fft_lin_out[7] + fft_lin_out[8])/7;

                //test each bucket against the average and threshold, play relevant tone.
                if (fft_lin_out[2] > average && fft_lin_out[2] >= 300)  { tone (3,75,pl); }
                if (fft_lin_out[3] > average && fft_lin_out[3] >= 140)  { tone (3,112,pl); }
                if (fft_lin_out[4] > average && fft_lin_out[4] >= 100)  { tone (3,150,pl); }
                if (fft_lin_out[5] > average && fft_lin_out[5] >=90)    { tone (3,187,pl); }
                if (fft_lin_out[6] > average && fft_lin_out[6] >= 90)   { tone (3,225,pl); }
                if (fft_lin_out[7] > average && fft_lin_out[7] >= 70)   { tone (3,262,pl); }
                if (fft_lin_out[8] > average && fft_lin_out[8] >= 70)   { tone (3,300,pl); }
                delay(200);
        }
}
```

APPENDIX B: MOVER TECHNICAL DETAILS

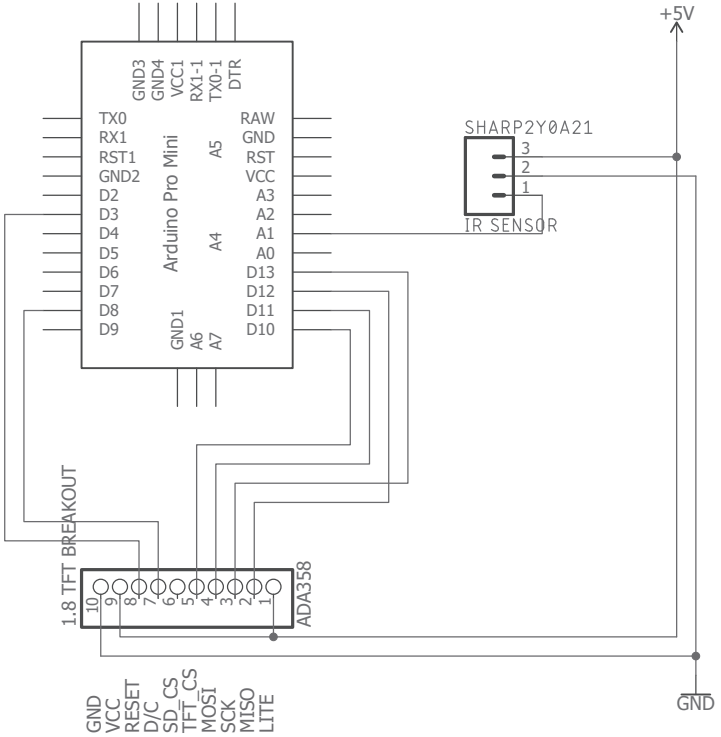



```
#include <Servo.h>// include servo library
Servo myservo1;     // create servo objects
Servo myservo2;
long n;                         // variable for lies
int pos = 0;                    // variable for servo position
int LEDf = 5;                   // variable for LED indicating backwards
int LEDb = 6;                   // variable for LED indicating forwards
int brightness = 0;             // LED brightness

void setup() {
        randomSeed(analogRead(0));
        myservo1.attach(9);
        myservo2.attach(10);
}
```

```
void loop() {
        n = random(1,5);
        if n == 1 {
                flashBack();
                goBack();
        }

        if n == 2 {
                flashBack();
                goFwd();
        }

        if n == 3 {
                flashFwd();
                goBack();
        }

        if n == 4 {
                flashFwd();
                goFwd();
        }
}

void flashBack() {                      // turn up brightness of backward LED until full
        for (brightness = 0; brightness < 255; brightness += 5) {
                analogWrite(LEDb, brightness);
                delay(50);
        }
}

void flashFwd() {                       // turn up brightness of backward LED until full
        for (brightness = 0; brightness < 255; brightness += 5) {
                analogWrite(LEDf, brightness);
                delay(50);
        }
}

void goBack() {                         // move servos to go backwards
        myservo1.write(100);
        myservo2.write(80);
        delay(1000);
        myservo1.write(90);
        myservo2.write(90);
```

```
        analogWrite(LEDb, 0);                   // turn off backward LED
        analogWrite(LEDf, 0);                   // turn off forward LED
}

void goFwd() {                                  // move servos to go forwards
        myservo1.write(80);
        myservo2.write(100);
        delay(1000);
        myservo1.write(90);
        myservo2.write(90);
        analogWrite(LEDb, 0);       // turn off backward LED
        analogWrite(LEDf, 0);                   // turn off forward LED
}
```

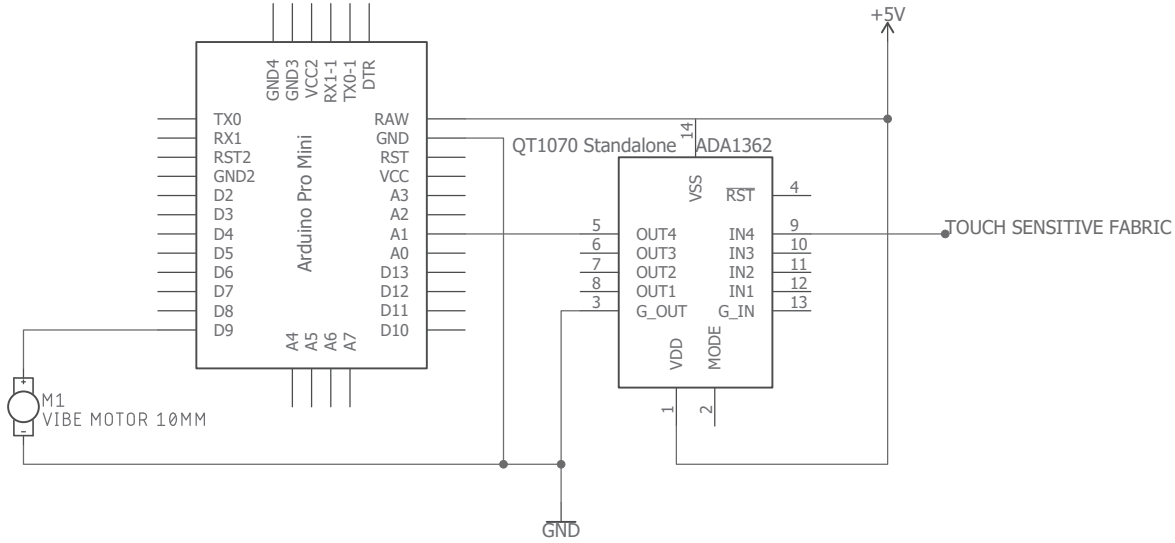
APPENDIX C: COLOURMAPPER TECHNICAL DETAILS




```
/*
Incorporates elements of graphicstest.ino for the Adafruit 1.8" SPI display, by Limor Fried/Ladyada for Adafruit Industries, June 23, 2017. https://github.com/adafruit/Adafruit-ST7735-Library. Made available under MIT license.
*/

#include <Adafruit_GFX.h>
#include <Adafruit_ST7735.h>
#include <SPI.h>

Adafruit_ST7735 tft = Adafruit_ST7735(10, 8, 3);              //TFT_CS,  TFT_DC, TFT_RST
unsigned int sensor;
unsigned int colourout;
const int screenlite = 2;
```

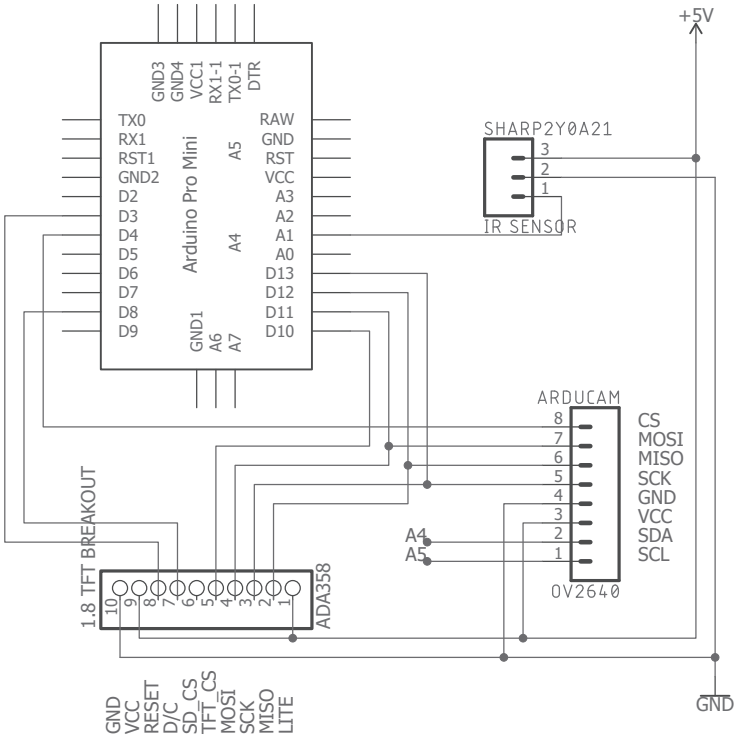
```
void setup() {
	tft.initR(INITR_BLACKTAB);			// initialize ST7735S chip
	pinMode (screenlite, OUTPUT);
}

void loop() {
	sensor = analogRead(A1);
	delay(100);

	// map the distance sensor to a colour range and push to LCD
	if (sensor >=70 && sensor <=480) {
		unsigned int colour = map(sensor, 70, 480, 0, 31);
		if  (colour <=15) {
			colourout = (colour*4096);
		}
		else {
			colourout = (((colour-16)*256)+61440);
		}
		digitalWrite(screenlite, HIGH);
		tft.fillScreen(colourout);
		delay(50);
	}

	else {
		tft.fillScreen(0x0000);
		digitalWrite(screenlite, LOW);
	}
 }
```

APPENDIX D: TOUCHBUZZER TECHNICAL DETAILS




```
int touch;
int buzzPin = 9;
int n;

void setup() {
        pinMode (buzzPin, OUTPUT);
        Serial.begin(9600);
}

void loop() {
        touch = analogRead(A1);                 //read touch sensor

        if (touch <= 50) {
                digitalWrite (buzzPin, HIGH);   //if above threshold, turn on buzz motor
                n = random(10);
                delay(n*200);                           //delay for a random period of time
                digitalWrite (buzzPin, LOW);            //turn off buzz motor
                delay(n*100);
        }
        delay(100);
}
```

APPENDIX E: GAZE RETURNER TECHNICAL DETAILS



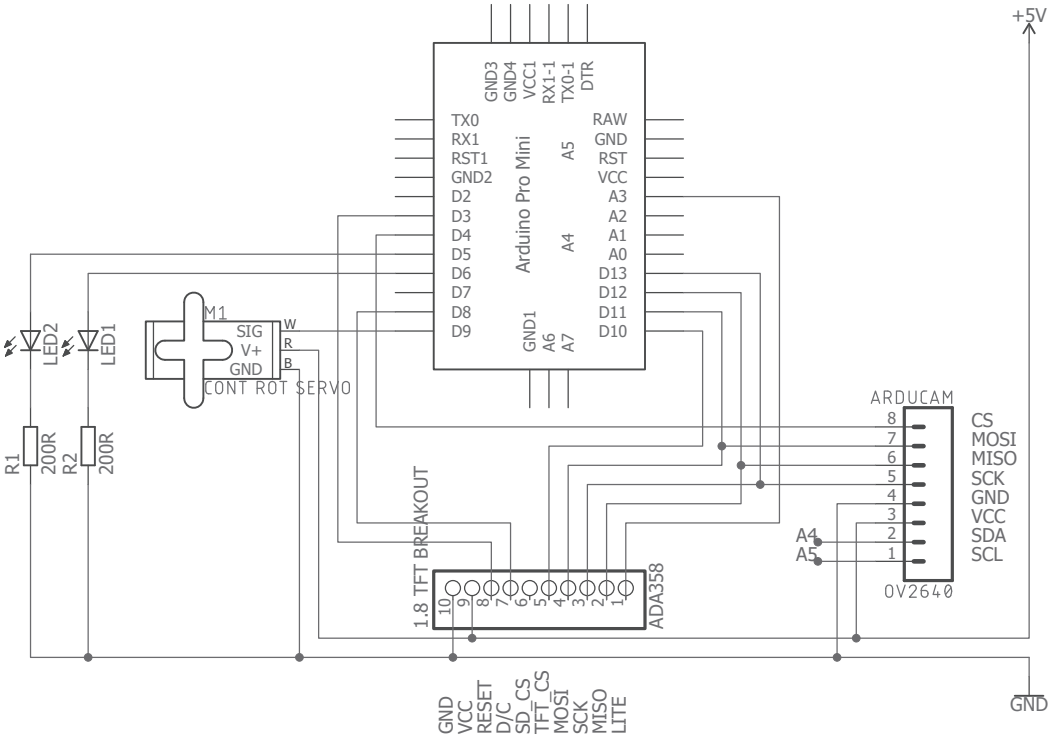

```
/*
Incorporates elements of the following open source sketches:
1. spitftbitmap.ino for the Adafruit 1.8" SPI display, by Limor Fried/Ladyada for Adafruit Industries, June 23, 2017.
https://github.com/adafruit/Adafruit-ST7735-Library. Made available under MIT license.
2. arducam_lcd1_0.ino, by oric_dan, February 7, 2016. https://forum.arduino.cc/index.php?topic=377651.0. http://
forum.arduino.cc/index.php?topic=376790.0.
3. timelapse_1.ino, by Ben Sauerwine. July 25, 2013. https://sauerwine.blogspot.com.au/2013/07/an-arduino-time-
lapse-camera-using.html. Based on open source demo made for the Omnivision OV2640 sensor, available at arducam.
com.
4. ArduCAM_GPIO_TRIG.ino by Lee Jackson, December 15, 2012. http://www.arducam.com/how-arducam-use-a-
external-trigger-from-a-sensor/
*/
```

```
#include <Adafruit_GFX.h>
#include <Adafruit_ST7735.h>
#include <Wire.h>
#include <ArduCAM.h>
#include <SPI.h>
#include <memorysaver.h>
#include <avr/pgmspace.h>
#include <ov2640_regs.h>

#define DISP_ROTATE  3     //values 1-4, rotates image 90 degrees on screen
#define TFT_CS  10         //Chip select line for TFT display
#define T FT_RST  3        //Reset line for TFT
#define TFT_DC   8         //Data/command line for TFT

const int CAM_CS = 4;      //camera call pin
const int screenlite = A2; //pin for turning screen backlight on and off
int colourval;                        //store mapped colour
int distance;
int invertdistance;
byte colourout;
float volts;
float colour;
// instantiate LCD and ArduCAM.
Adafruit_ST7735 tft = Adafruit_ST7735(TFT_CS, TFT_DC, TFT_RST);
ArduCAM myCAM1(OV2640, CAM_CS);

// load and unload over SPI bus
#define cam_assert()   digitalWrite(CAM_CS,LOW)
#define cam_desert()   digitalWrite(CAM_CS,HIGH)
#define lcd_assert()   digitalWrite(TFT_CS,LOW)
#define lcd_desert()   digitalWrite(TFT_CS,HIGH)

void setup() {
        uint8_t vid, pid, temp;
        Wire.begin();
        SPI.begin();
        pinMode(CAM_CS, OUTPUT);
        pinMode (screenlite, OUTPUT);
        digitalWrite (screenlite, LOW);
        // Initialise screen
        tft.initR(INITR_BLACKTAB);
        tft.setRotation(DISP_ROTATE);  //set rotation for images.
```

```
        //test the SPI bus is working
        myCAM1.write_reg(ARDUCHIP_TEST1, 0x55);
        temp = myCAM1.read_reg(ARDUCHIP_TEST1);
        if (temp != 0x55) {
                while (1);
        }

        // change MCU mode
        myCAM1.write_reg(ARDUCHIP_MODE, 0x00);
        myCAM1.InitCAM();
}

void loop() {
        //read sensor and convert to distance
        float IRval = analogRead(A1)*0.0048828125;
        distance = (pow(IRval, -1.1))*63;
        if (distance >=50 && distance <=135) {
                invertdistance = 135-distance;          //map distance to colour
                colour = invertdistance/5.67;
                colourout =round(colour);
                colourval = colourout * 4096;                   //convert colour value to redscale
                digitalWrite(screenlite, HIGH);         //turn on screen
                tft.fillScreen(colourval);              //push colour to screen
                delay(500);
        }

        else if (distance <50 && distance >=23) {
                startCapture();                         //take picture to buffer
                tft.fillScreen(0);                      //push black to screen
                digitalWrite (screenlite, HIGH);
                capture2Lcd();                          //push buffer to screen
                delay(7500);
                digitalWrite (screenlite, LOW);         //turn off screen
        }

        else {
                delay(50);
        }
}
```

```
void capture2Lcd() {                                    //converts image and pushes to screen
        unsigned char VH, VL;          //define high and low bytes, must be unsigned.
        uint8_t temp;
        int row, col;
        int xo = 0, yo = 4;                 //start position of displayed image.
        uint16_t color;
        unsigned long prevtm;
        prevtm = millis();
        int w = 160, h = 128;               // set TFT address window bounds to entire screen.
        tft.setAddrWindow(xo, yo, xo + w - 1, yo + h - 1);

        // read 320x240x2 bytes from FIFO, draw every other row, and every other pixel
        for ( row = 0; row < 240; row++) {                              // for every row
                for ( col = 0; col < (320 / 2); col++) {                // for every other column
                        cam_assert();
                        VH = myCAM1.read_fifo();                //get every other pixel
                        VL = myCAM1.read_fifo();
                        temp = myCAM1.read_fifo();              //discard next pixel.
                        temp = myCAM1.read_fifo();
                        cam_desert();
                        if ( (row % 2) == 0) {                                  //draw only every other row.
                                lcd_assert();
                                color = (VH << 8) — VL;         //compute RGB565 color.
                                tft.pushColor(color);
                                lcd_desert();
                        }
                }
        }
}

void startCapture( ) {                                                  //takes image as BMP
        myCAM1.write_reg(ARDUCHIP_MODE, 0x00);
        myCAM1.set_format(BMP);
        myCAM1.InitCAM();
        myCAM1.flush_fifo();                                    //clear ArduCAM buffer.
        myCAM1.clear_fifo_flag();                               //start capture.
        myCAM1.start_capture();
        while ( !(myCAM1.read_reg(ARDUCHIP_TRIG) & CAP_DONE_MASK) ) {
                delay(10);
        }                                                               //wait for buffer
        myCAM1.clear_fifo_flag();
        myCAM1.InitCAM();
}
```

APPENDIX F: MOUBIE TECHNICAL DETAILS




```
/*
Incorporates elements of the following open source sketches:
1. spitftbitmap.ino for the Adafruit 1.8" SPI display, by Limor Fried/Ladyada for Adafruit Industries, June 23, 2017.
https://github.com/adafruit/Adafruit-ST7735-Library. Made available under MIT license.
2. arducam_lcd1_0.ino, by oric_dan, February 7, 2016. https://forum.arduino.cc/index.php?topic=377651.0. http://
forum.arduino.cc/index.php?topic=376790.0.
3. timelapse_1.ino, by Ben Sauerwine. July 25, 2013. https://sauerwine.blogspot.com.au/2013/07/an-arduino-time-
lapse-camera-using.html. Based on open source demo made for the Omnivision OV2640 sensor, available at arducam.
com.
4. ArduCAM_GPIO_TRIG.ino by Lee Jackson, December 15, 2012. http://www.arducam.com/how-arducam-use-a-
external-trigger-from-a-sensor/
*/
```

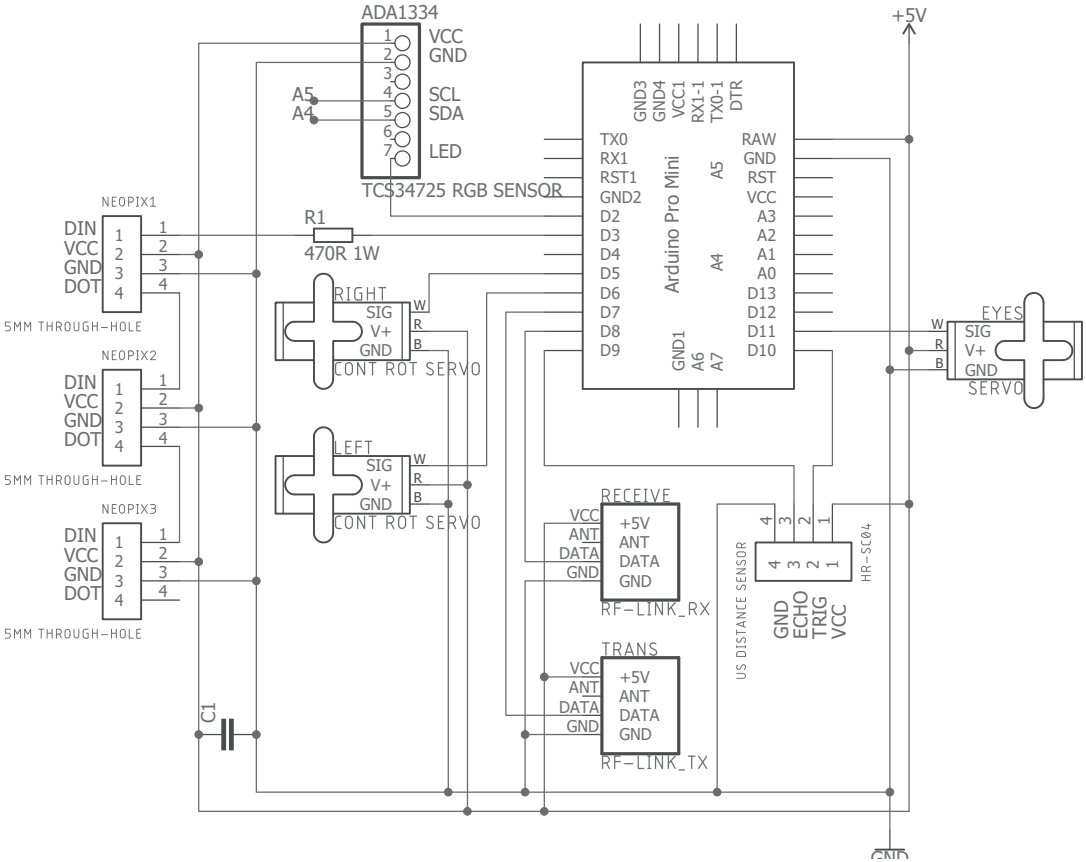
```
#include <Adafruit_GFX.h>
#include <Adafruit_ST7735.h>
#include <Wire.h>
#include <ArduCAM.h>
#include <SPI.h>
#include <memorysaver.h>
#include <avr/pgmspace.h>
#include <ov2640_regs.h>
#include <Servo.h>
#define DISP_ROTATE  3
#define TFT_CS  10
#define TFT_RST  3
#define TFT_DC   8

Servo walk;
int pos = 0;
const int CAM_CS = 4;
const int screenlite = A3;
int LEDf = 5;
int LEDb = 6;
long fbn;
int brightness = 0;
// instantiate LCD and ArduCAM.
Adafruit_ST7735 tft = Adafruit_ST7735(TFT_CS, TFT_DC, TFT_RST);
ArduCAM myCAM1(OV2640, CAM_CS);

// load and unload over SPI bus
#define cam_assert()   digitalWrite(CAM_CS,LOW)
#define cam_desert()   digitalWrite(CAM_CS,HIGH)
#define lcd_assert()   digitalWrite(TFT_CS,LOW)
#define lcd_desert()   digitalWrite(TFT_CS,HIGH)

void setup() {
        uint8_t vid, pid, temp;
        Serial.begin(115200);
        Wire.begin();
        SPI.begin();
        pinMode(CAM_CS, OUTPUT);
        pinMode (screenlite, OUTPUT);
        digitalWrite (screenlite, LOW);
        pinMode(LEDf, OUTPUT);
        pinMode(LEDb, OUTPUT);
```

```
        walk.attach(9);                 //attach servo and turn off
        walk.write(90);

        // Initialise screen
        tft.initR(INITR_BLACKTAB);
        tft.setRotation(DISP_ROTATE);   //set rotation for images.
        tft.fillScreen(0);              //push black to screen

        //test the SPI bus is working
        myCAM1.write_reg(ARDUCHIP_TEST1, 0x55);
        temp = myCAM1.read_reg(ARDUCHIP_TEST1);
        if (temp != 0x55) {
                while (1);
        }
        myCAM1.write_reg(ARDUCHIP_MODE, 0x00);
        myCAM1.InitCAM();
}

void loop() {
        fbn = random(2);

        if (fbn == 1) {
                int x = 1;
                for (x = 1; x < 4; x++) {
                        for (brightness = 0; brightness < 255; brightness += 5) {
                                analogWrite(LEDb, brightness);
                                delay(30);
                        }
                }
                 analogWrite(LEDb, 0);
                walk.write(100);
                delay(3000);
                walk.write(90);
        }

        else {
                int x = 1;
                for (x = 1; x < 4; x++) {
                        for (brightness = 0; brightness < 255; brightness += 5) {
                                analogWrite(LEDf, brightness);
                                delay(30);
                        }
                }
```

```
                analogWrite(LEDf, 0);
                walk.write(75);
                delay(3000);
                walk.write(90);
        }
        startCapture();                         //take picture to buffer
        digitalWrite (screenlite, HIGH);
        capture2Lcd();                          //push buffer to screen
        delay(500);
}

void capture2Lcd() {
        unsigned char VH, VL;
        uint8_t temp;
        int row, col;
        int xo = 0, yo = 4;
        uint16_t color;

        // set TFT address window bounds to entire screen.
        int w = 160, h = 128;
        tft.setAddrWindow(xo, yo, xo + w - 1, yo + h - 1);

        // read 320x240x2 bytes from FIFO, draw every other row, and every other pixel
        for ( row = 0; row < 240; row++) {
                for ( col = 0; col < (320 / 2); col++) {
                        cam_assert();
                        VH = myCAM1.read_fifo();        //get every other col pixel.
                        VL = myCAM1.read_fifo();
                        temp = myCAM1.read_fifo();      //toss next pixel.
                        temp = myCAM1.read_fifo();
                        cam_desert();
                        if ( (row % 2) == 0) {                  //draw only every other row.
                                lcd_assert();
                                color = (VH << 8) — VL;         //compute RGB565 color.
                                tft.pushColor(color);
                                lcd_desert();
                        }
                }
        }
}
```

```
void startCapture() {
        myCAM1.write_reg(ARDUCHIP_MODE, 0x00);
        myCAM1.set_format(BMP);
        myCAM1.InitCAM();
        myCAM1.flush_fifo();                                    //clear ArduCAM buffer.
        myCAM1.clear_fifo_flag();                               //start capture.
        myCAM1.start_capture();
        while ( !(myCAM1.read_reg(ARDUCHIP_TRIG) & CAP_DONE_MASK) ) {
                delay(10);
        }
  myCAM1.clear_fifo_flag();
  myCAM1.InitCAM();
}
```

APPENDIX G: SOME ASSEMBLY TECHNICAL DETAILS




```
/*
Incorporates elements of the following open source sketches:
1. tcs34725.ino for the Adafruit TCS34725 library, by Kevin Townsend for Adafruit Industries, December 4, 2015. https://github.com/adafruit/Adafruit_TCS34725. Made available under BSD license.
2. simple.ino for the Adafruit NeoPixel library, by Shae Erisson, 2013. https://github.com/adafruit/Adafruit_NeoPixel. Made available under the LGPL-3.0 license.
3.ETVirtualWireDemoRX.ino and ETVirtualWireDemoTX.ino for the Easy Transfer library, by BillPorter, January 2016. http://www.billporter.info/easytransfer-arduino-library/. Made available under CC BY-SA 3.0 license.
4. threeservos.ino for the ServoTimer2 library, by Nick Bontrager, April 17, 2013. https://github.com/nabontra/ServoTimer2.
*/
```

```
int n = 0;
int m = 0;
int t = 0;
int c, p, r;
int ID = 1;                                   // ID that determines triggerbot <= pop.
int pop = 12;

//RF coms
#include <VirtualWire.h>
#include <EasyTransferVirtualWire.h>
EasyTransferVirtualWire ET; //create object
struct SEND_DATA_STRUCTURE                    //create data variables
{
        byte trigger;
};
SEND_DATA_STRUCTURE mydata;           //name data package

//servos
#include <ServoTimer2.h>
#define walkLpin 5
#define walkRpin 6
#define eyespin 11
ServoTimer2 walkL;
ServoTimer2 walkR;
ServoTimer2 eyes;
//US
#define echoPin 9 // Echo Pin
#define trigPin 10 // Trigger Pin

//colour sensor
#include <Wire.h>
#include "Adafruit_TCS34725.h"
Adafruit_TCS34725 tcs = Adafruit_TCS34725(TCS34725_INTEGRATIONTIME_700MS, TCS34725_GAIN_4X);
int sLED = 2;
int rd, gd, bd;

//neopixels
#include <Adafruit_NeoPixel.h>
#ifdef __AVR__
#include <avr/power.h>
#endif
#define PIN  3
#define NUMPIXELS      3
```

```
Adafruit_NeoPixel pixels = Adafruit_NeoPixel(NUMPIXELS, PIN, NEO_GRB + NEO_KHZ800);
int delayval = 5000;

//evasion
long duration;                  //duration used to calculate distance
long distance;
int dt = 10;                    //threshold for evasion
int pos, i;
int posmid = 1500;              //variables to store the eye servo position
int posmin = 1200;
int posmax = 1800;
int rmid = 1500;    //mid position for right wheel
int lmid = 1500;                        //mid position for right wheel
int lmax, lmin, rmax, rmin;
int flagL = 0;
int flagR = 0;

void setup() {
        //servos
        rmax = (rmid + 200);                            //calculate max and min positions from mid
        rmin = (rmid - 200);
        lmax = (lmid + 200);
        lmin = (lmid - 200);
        walkL.attach(walkLpin);             //attach servos and turn off
        walkL.write(lmid);
        walkR.attach(walkRpin);
        walkR.write(rmid);
        eyes.attach(eyespin);
        eyes.write(posmid);

        // US
        pinMode(trigPin, OUTPUT);
        pinMode(echoPin, INPUT);

        // RF coms
        ET.begin(details(mydata));  //initiate and pass in the data details
        vw_set_ptt_inverted(true);          // Initialise the IO and ISR
        vw_set_tx_pin(7);
        vw_set_rx_pin(8);
        vw_setup(2000);                     //Set bit rate
        mydata.trigger = 0;
```

```
	//colour sensor
	pinMode (sLED, OUTPUT);
	digitalWrite(sLED, LOW);
	tcs.begin();

	//neopixels
	pixels.begin(); // initializes the NeoPixel library.
	for (i = 0; i < NUMPIXELS; i++) {
		pixels.setPixelColor(i, pixels.Color(0, 0, 0)); // Moderately bright green color.
		pixels.show(); // This sends the updated pixel color to the hardwar
	}
	delay(20000);
}

void loop() {
	if (n < 60) {                                                    //case 1
		coloursense();
		if (c >= 1000) {
			colourdisplay();
			delay(delayval);
			gd = 0; rd = 0; bd = 0;
			colourdisplay();
		}
		delay(100);
	}
	if (n >= 60 && n < 120) {                          //case 2
		coloursense();
		if (c >= 1000) {
			colourdisplay();
			delay(delayval);
			gd = 0; rd = 0; bd = 0;
			colourdisplay();
		 }
		fakeScan();
	}
	if (n >= 120 && n < 180) {                         //case 3
		coloursense();
		if (c >= 1000) {
			colourdisplay();
			delay(delayval);
			gd = 0; rd = 0; bd = 0;
			colourdisplay();
		}
```

```
                fakeScan();
                goBack();
        }
        if (n >= 180) {                                 //case 4
                if (ID == 1) {
                        Trigger();
                }
                else {
                        Listen();
                }
                ID++;
                if (ID > pop) {
                        ID = 1;
                }
        }
        delay (100);
        n++;
}

void evade() {                                  //if distance is under the threshold distance, test
                                                until you find an exit condition
        flagL = 0;
        flagR = 0;
        scanL();
        if (flagL == 0) {
                lookForward();
                scanR();
                if (flagR == 0) {
                        lookForward();
                        goBack();
                        Listen();
                }
        }

        if (flagL == 1) {               //follow the test flags to avoid
                avoidL();
        }

        else if (flagR == 1) {
                avoidR();
        }
}
```

```
void goForward() {                          //moves the servos to go forward
        walkL.write(lmin);
        walkR.write(rmax);
        delay(50);
        walkL.write(lmid);
        walkR.write(rmid);
        delay(10);
}

void testDistance() {                               //tests distance to obstacles using US sensor
        digitalWrite(trigPin, LOW);
        delayMicroseconds(2);
        digitalWrite(trigPin, HIGH);
        delayMicroseconds(10);
        digitalWrite(trigPin, LOW);
        duration = pulseIn(echoPin, HIGH);
        distance = duration / 58.2;
        Serial.println(distance);
}

void lookForward() {                                //resets US sensor to forward position
        if (pos > posmid) {
                for (pos = posmax; pos > (posmid + 5); pos -= 5) {
                        eyes.write(pos);
                        delay(5);
                }
        }

        else if (pos < posmid) {
                for (pos = posmin; pos < (posmid - 5); pos += 5) {
                        eyes.write(pos);
                        delay(5);
                }
        }
}

void fakeScan() {                           //emulates scanning with no test distance
        for (pos = posmid; pos < posmax; pos += 5) {
                eyes.write(pos);
                delay(5);
        }
        lookForward();
        for (pos = posmid; pos > posmin; pos -= 5){
```

```
                eyes.write(pos);
                delay(5);
        }
        lookForward();
}

void scanL() {                                          //scan to the left
        for (pos = posmid; pos < posmax; pos += 5) {
                eyes.write(pos);
                delay(5);
                testDistance();
                if (distance > dt) {
                        lookForward();
                        flagL = 1;
                        break;
                }
        }
}

void scanR() {                                          //scan to the right
        for (pos = posmid; pos > posmin; pos -= 5) {
                eyes.write(pos);
                delay(5);
                testDistance();
                if (distance > dt) {
                        lookForward();
                        flagR = 1;
                        break;
                }
        }
}

void goBack() {                                         //moves the servos to go backward
        walkL.write(lmax);
        walkR.write(rmin);
        delay(200); //400, 200, 100
        walkL.write(lmid);
        walkR.write(rmid);
}
```

```
void avoidR() {                                 //rotates right whilst under distance threshold
        testDistance();
        while (distance <= dt) {
                walkR.write(rmax);
                delay(20);
                walkR.write(rmid);
                testDistance();
        }
        flagR = 0;
}

void avoidL() {                                 //rotates left whilst under distance threshold
        testDistance();
        while (distance <= dt) {
                walkL.write(lmin);
                delay(20);
                walkL.write(lmid);
                testDistance();
        }
        flagL = 0;
}

void Listen() {                                 //receives timing of triggered colour display
        vw_rx_start();                          // Start the receiver PLL running
        delay(500);
        if (ET.receiveData()) {                 //check and see if a data packet has come in.
                while (mydata.trigger == 1) {   //if display is trigggered
                        (ET.receiveData());
                }
                vw_rx_stop();                           //stop listening
                delay(20);
                coloursense();
                colourdisplay();
        }
        delay(delayval);
        gd = 0; rd = 0; bd = 0;
        colourdisplay();
        vw_rx_stop();
}
```

```
void Trigger() {                                    //trigger sequence for display timing
        mydata.trigger = 0;
        coloursense();
        if (c >= 1000) {                                    //if colour is not black
                mydata.trigger = 1;
                for (r = 0; r < 50; r++) {          //broadcast trigger on
                        ET.sendData();
                        delay(5);
                }
                delay(100);
                mydata.trigger = 0;                 //broadcast trigger off
                for (r = 0; r < 5; r++) {
                        ET.sendData();
                        delay(5);
                }
                coloursense();                              //sense and display colour
                colourdisplay();
                delay(delayval);
                gd = 0; rd = 0; bd = 0;
                colourdisplay();
                t = 0;
        }
}

void coloursense() {                                //analyse colour below using colour sensor
        uint16_t clear, red, green, blue;
        tcs.getRawData(&red, &green, &blue, &clear);
        float r, g, b;
        c = clear;
        uint32_t sum = red + green + blue;  //calculate values of each colour channel
        r = red; r /= sum;
        g = green; g /= sum;
        b = blue; b /= sum;
        rd = r * 400;                                       //convert to integers to feed neopixels
        gd = g * 400;
        bd = b * 400;
        if (rd > 255) {                                     //convert irregular values to max
                rd = 255;
        }
        if (gd > 255) {
                gd = 255;
        }
```

```
        if (bd > 255) {
                bd = 255;
        }
        if (sum < 1000) {                       //threshold for black
                rd = 0;
                gd = 0;
                bd = 0;
        }
}

void colourdisplay() {                                  //pushes colour value to LEDs
        for (i = 0; i < NUMPIXELS; i++) {
                pixels.setPixelColor(i, pixels.Color(gd, rd, bd));
                pixels.show();
        }
}
```